Patient Monitor BP-S510

Operation Manual

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Directive

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- The contents of this manual should be correct. If, for some reason, there are any questionable points, please do not hesitate to contact our service center.
- The manual will be replaced if any pages are missing or collation is incorrect.

Warranty

- Please contact your local distributor about the warranty period.
- Device failure or damage related to the following situations during the guarantee period is not covered by this warranty:
    - Installation, transfer installation, maintenance and repairs by any person other than an authorized Colin Medical Technology employee or technician specified by Colin Medical Technology.
    - Damage sustained to the Colin Medical Technology product(s) caused by product(s) from another company excluding products delivered by Colin Medical Technology.
    - Damage – caused by mishandling and/or misuse – is the responsibility of the user.
    - Maintenance and repairs utilizing maintenance components that are not specified by Colin Medical Technology.
    - Device modifications or use of accessories not recommended by Colin Medical Technology.
    - Damage caused by accidents or natural disasters (earthquakes, flooding, etc.).
    - Damage resulting from usage where caution statements and operating instructions shown in this manual have not been followed.
    - Damage due to neglect of specified maintenance checks.
- This warranty only covers the hardware of the BP-S510. The warranty does not cover the following selections:
    - Whatever damage or loss results from the attachment of accessories or their operation.
    - In the event of a defect in the product, contact our sales outlet or EU representative as noted on the back cover.

- The BP-S510 conforms to the EMC standard IEC60601-1-2.
  Note that mobile phones should not be used in the vicinity of the BP-S510.

Note, however, any device not complying to the EMC standard that is used with the BP-S510 renders the BP-S510 as non-compliable to the EMC standard.

Trademark

Product brand names shown in this manual are likely to be the trademark or registered trademark of the company concerned.

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SAFETY INFORMATION

General Safety Information

This section contains important safety information related to general use of the BP-S510 multi-parameter patient monitor. Other important safety information appears throughout the manual. The BP-S510 will be referred to as the monitor throughout this manual.

Important! Before use, carefully read this manual, accessory directions for use, all precautionary information and specifications.

Warning

Warnings are identified by the WARNING symbol shown above.

Warnings alert you to potential serious outcomes (death, injury, or adverse events) to the patient or user.

	WARNING: Do not take into or use the monitor in locations where highly combustible anesthetics or flammable gases are used or in high-pressure oxygen rooms or inside oxygen tents, as this may cause a flammable explosion.
	WARNING: When using the monitor with a commercial electric power source, use the monitor with an electric power wall socket with a grounding wire for medical use. Not doing so could cause electric shock.
	WARNING: Do not connect grounding wire to gas pipes. This could cause fire.
	WARNING: Only doctors and officially certified personnel should use this monitor. Do not allow patients to touch this monitor. Allowing patients to touch this monitor could cause accidents.
	WARNING: This monitor cannot be used when MRI is in progress. If MRI is in use, keep patient attachments away from patients to prevent accidents.
	WARNING: The monitor conforms to the requirements of the EMC standard (IEC60601-1-2), and may therefore be used simultaneously with pacemakers and other electrical simulators. It should, however, be noted that the BP-S510 may be affected by electrical scalpels and microwave therapeutic apparatus. Please check operation of the monitor during and after use of such equipment.
	WARNING: Do not take mobile phones or transceivers into a room where this monitor is installed, as such devices may cause accidents.
	WARNING: In order to avoid accidents, do not use any unauthorized accessories or options.
	WARNING: Thoroughly read the instruction manuals supplied with accessories and options to ensure correct use. This instruction manual does not carry the caution selections for such equipment.
	WARNING: Do not open cover or disassemble this monitor. Doing so could cause electric shock or fire. It is prohibited by law to modify the monitor without authorization.
	WARNING: Do not use power source other than the specified voltage, (100-240V~50/60Hz) as this may cause fire or electric shock.

WARNING: Pre-use inspection and preventive maintenance must be performed for safe use.

WARNING: The monitor may be used with electrical surgical equipment.

Follow the instruction manuals for medical instruments – notably electrosurgical and diathermy instruments – when used, as their high – frequency energy units may cause burns to patients via attachments.

WARNING: This monitor is protected against the discharge of a defibrillator. But do not touch the monitor when a defibrillator is being discharged (electrified), as doing so may cause electric shock.

WARNING: The following cautions apply when connecting he monitor with other equipment.

1. **Ensure that the connected equipment is in accordance with the IEC60601-1 or IEC safety standards, so that the system complies with IEC60601-1.**
2. **Employ additional protective measures (e.g. additional protective earthing) as necessary.**

WARNING: Do not connect devices that do not meet medical safety standards (such as commercial PCs), as they may cause electric shock. This monitor meets the restricted level of leakage current required for medical devices. Therefore, this monitor cannot be connected to a device that would give a combined total of leakage current beyond the restricted level.

WARNING: Do not place anything on top of this monitor. If something is spilled over the monitor or gets into it, such spillage may cause fire or electric shock. If fluid spills on the monitor accidentally, disconnect power cord, wipe dry immediately, and have the monitor serviced to make sure that no hazard exists.

WARNING: Do not place heavy objects on the power cord, as doing so may cause fire or electric shock.

WARNING: Before conducting maintenance work, turn the power OFF and unplug the power cord from the wall socket to prevent electric shock.

WARNING: When the following occur, turn the power OFF immediately and unplug the power cord from the wall socket. Continued use in such situations may cause fire or electric shock.

- **There is smoke or a strange odor leaking out of the device.**
- **The devices has been dropped or impacted by an object.**
- **Liquid or foreign matter gets inside the device.**
- **Device failure has occurred.**

Also, when any of the above occurs, promptly do the following:

1. **Check to see that the power cord has been unplugged from the wall socket.**
2. **Place an "Out of Order" sign on the device and do not use it.**

WARNING: Do not connect more than one patient to the monitor. Do not connect more than one monitor to a patient.

WARNING: The patient monitor is a prescription device and is to be operated by qualified personnel only.

Cautions

Cautions are identified by the CAUTION symbol shown above.

Caution statements identify conditions or practices that could result in damage to the equipment or other property.

CAUTION: The monitor may not operate properly if it is operated or stored at conditions outside the ranges stated in this manual, or subjected to excessive shock or dropping.

CAUTION: When connecting the patient monitor to any instrument, verify proper operation before clinical use. Both the monitor and the instrument connected to it must be connected to a grounded outlet.

CAUTION: Accessory equipment connected to the monitor's data interface must be certified according to IEC60950 for data-processing equipment or IEC60601-1 for electromedical equipment. All combinations of equipment must be in compliance with IEC60601-1-1 system requirements. Anyone who connects additional equipment to the signal input or signal output port configures a medical system and is therefore responsible that the system complies with the requirements of IEC 60601-1-1 and the electromagnetic compatibility system standard IEC60601-1-2. If in doubt, consult Colin Medical Technology Technical Support Representative.

CAUTION: Risk of explosion if battery is replaced by an incorrect type.

CAUTION: Where the integrity of the external protective conductor in the installation or its arrangement is in doubt, equipment shall be operated from its internal electrical power source.

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INTRODUCTION

WARNING: Patient conditions may result in erroneous readings. If the measurements are suspect, verify the reading using another clinically accepted measurement method.

Intended Use for the BP-S510

The BP-S510 is intended to be used to monitor electrocardiography (ECG), heart rate (HR), noninvasive blood pressure (NIBP) - systolic, diastolic and mean arterial pressures, functional arterial oxygen saturation (SpO_2), pulse rate (PR), respiration (RR), temperature (Temp), invasive blood pressure (IBP) and capnography ($EtCO_2$ and $InCO_2$) for adult and neonatal patients in all areas of a hospital and hospital-type facilities. Monitor users should be skilled at the level of a technician, doctor, nurse or medical specialist.

Note: Hospital use typically includes such areas as general care floors, operating rooms, special procedure areas, intensive and critical care area, within the hospital. Hospital-type facilities include physician office-based facilities, sleep labs, skilled nursing facilities, surgical centers, and sub acute care centers.

About This Manual

This manual explains how to set up and use the BP-S510 patient monitor.

Read the entire manual including the *Safety Information* section, before you operate the monitor.

Identifying the BP-S510 monitor Configurations

The following table identities BP-S510 monitor configurations and how they are indicated. The model-option number and serial number are located on the back of the monitor.
All information in this manual, including the illustrations, is based on a monitor configured with the Capnography ($EtCO_2$ and $InCO_2$), IBP and recorder. If the relevant functions do not exist, please verify your unit configuration.

Configuration	REF No.	Description
BP-S510	112580	Standard (ECG, NIBP, SpO_2, 2-channel Temperature, Respiration)
BP-S510P	112581	Standard + Recorder
BP-S510C	112582	Standard + Capnography
BP-S510PC	112583	Standard + Capnography + Recorder
S510-IBP	131324	2-channel IBP module

Features for the BP-S510

Physical/Mechanical

The BP-S510 is a multi-parameter patient monitor which can be battery-operated when AC power source is not available.

Electrical

The BP-S510 is powered by an internal battery pack that typically provides one hour of monitoring from fully charged new batteries. The batteries are continuously recharged when the monitor is connected to AC power source. Refer to the **Battery Operation** section for details.

Display

The monitoring screen is a color LCD that shows all graphic and numeric patient information as well as status conditions and warning messages.

Jog dial

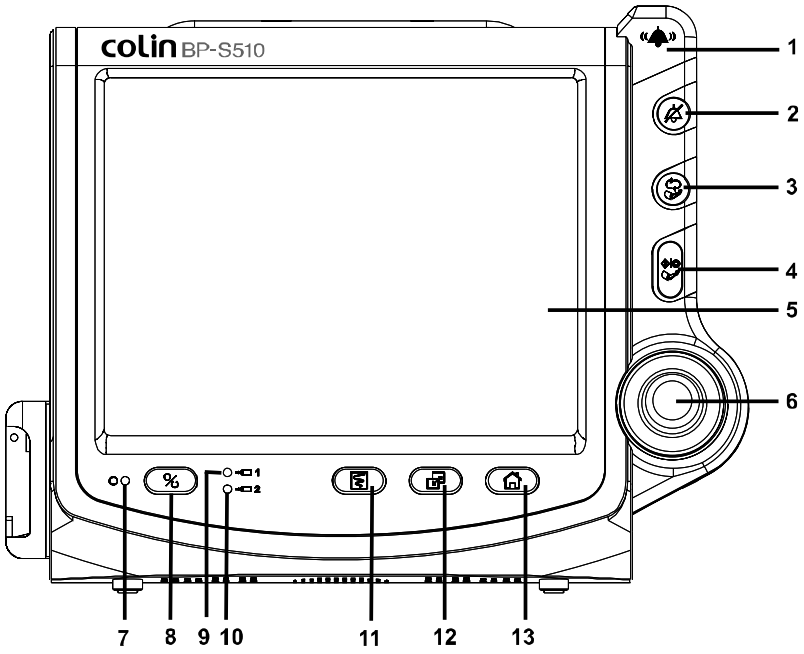
The jog dial provides user interaction with the display and the monitor functions. Rotating and pressing the jog dial allows the user to navigate and make changes to the display elements and monitor functions. Refer to the **Using the Monitor** section for details.

Auxiliary Outputs

The monitor provides RS-232, LAN and USB ports.

DESCRIPTION OF THE MONITOR

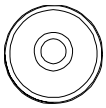
Front Panel Components



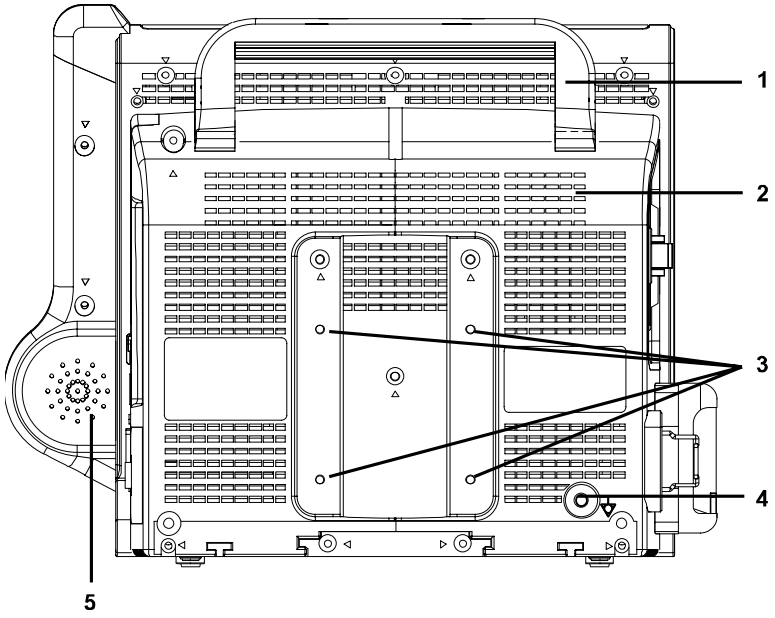
1 Visual alarm indicator
2 Alarm silence button
3 NIBP interval button
4 NIBP start/stop button
5 LCD
6 Jog dial
7 Power on indicator
8 Power on/off button
9 Battery charging indicator 1
10 Battery charging indicator 2
11 Record button
12 Trend button
13 Home button

Figure 1. Front Panel Components

Table 1. BP-S510 Controls

Symbols	Description
	Power on/off button turns the monitor on or off.
	Record button prints measured data if an optional recorder is installed.
	Alarm silence button silences the audible alarm temporarily. suspends the audible alarm by pressing over 2 seconds.
	NIBP interval button allow you to set the NIBP auto measurement interval.
	NIBP start/stop button toggles between starting and stopping NIBP measurements.
	Home button exits a menu displayed on the screen and goes to the main screen.
	Trend button allows you to set the trend display.
	**Jog dial** provides user interaction with the monitor to control the functions.

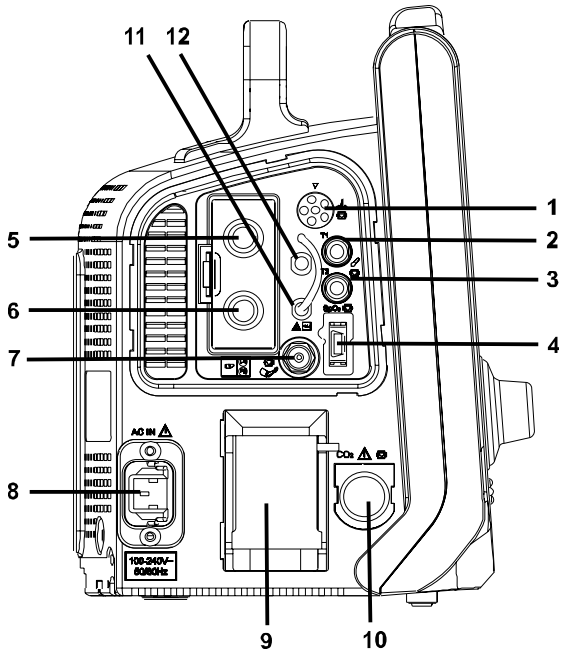
Rear Panel Components



1 Handle
2 Ventilators
3 VESA connector holes
4 Equipotential terminal
5 Speaker

Figure 2. Rear Panel Components

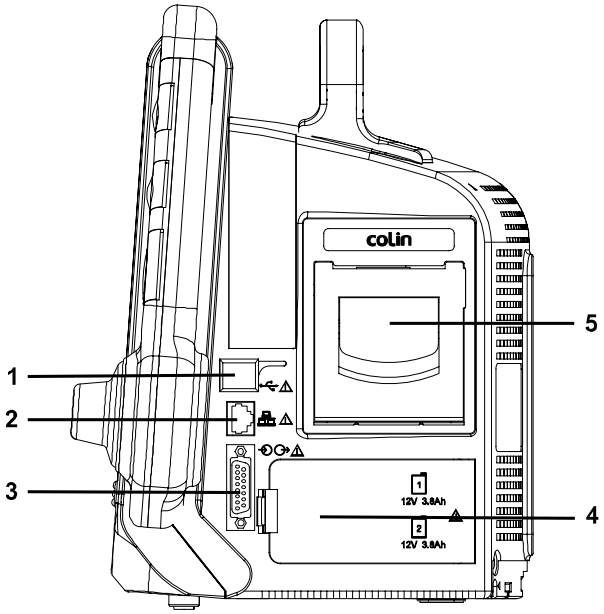
Left Panel Components



1	ECG connector	7	NIBP connector
2	Temperature channel 1	8	AC power connector
3	Temperature channel 2	9	Water trap (option)
4	SpO_2 connector	10	CO_2 connector (option)
5	IBP channel 1 (option)	11	CO_2 Filter (option)
6	IBP channel 2 (option)	12	CO_2 Exhaust port (option)

Figure 3. Left Panel Components

Right Panel Components



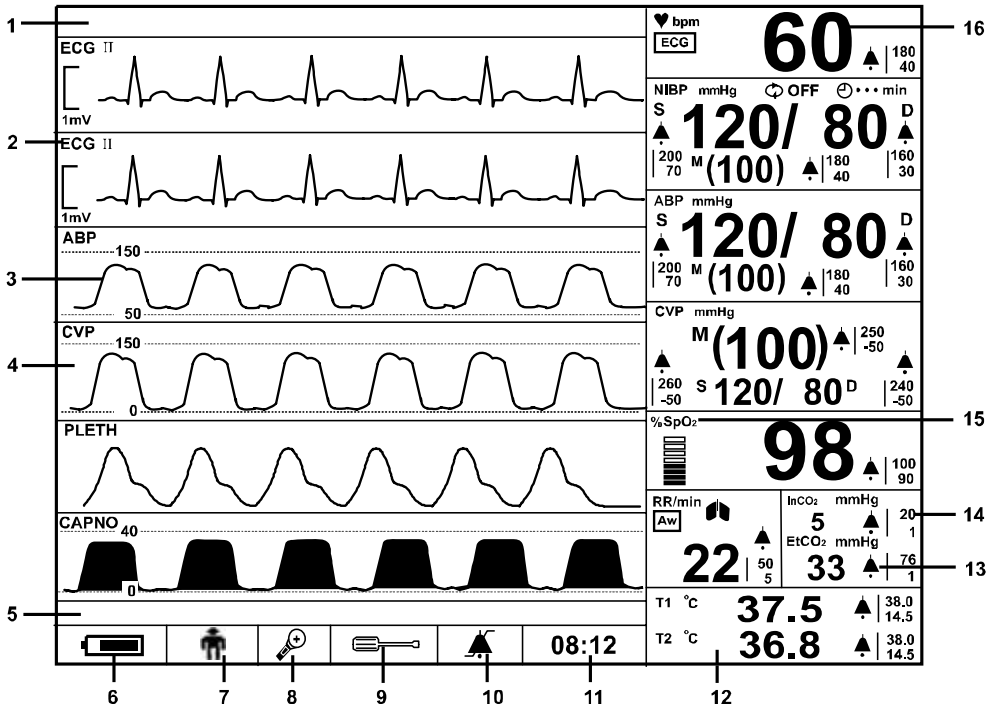
1 USB port
2 LAN port
3 RS-232 port
4 Battery cover
5 Recorder (option)

Figure 4. Right Panel Components

Table 2. Panel and Label Symbols

Symbols	Description	Symbols	Description
	Power on indicator		EU representative
	Battery charging indicator 1		Dust and water resistance
	Battery charging indicator 2		Attention, consult accompanying documents
	Visual alarm indicator		CE mark
	Type CF- Defibrillator proof		Crossed-out wheeled bin
	ECG connector		Manufacturer
	Temperature connector		Date of manufacture
SpO_2	SpO_2 connector	**REF**	Reference number
	NIBP connector	**SN**	Serial number
	IBP connector		Environmental shipping/storage altitude limitations
CO_2	CO_2 connector		Environmental shipping/storage humidity limitations
	CO_2 Filter		Environmental shipping/storage temperature limitations
	USB port		Fragile-handle with care
	LAN port		This way up
	RS-232 interface port		Keep dry
	Battery placement & rating		Attention: consult accompanying documents
	Equipotential terminal		Handle with care
	AC power input rating		Stack up to 3 boxes

Displays



1	Alarm message area	9	Setup icon
2	Title of waveform parameter	10	Alarm limits icon
3	Waveform	11	Time display
4	Waveform area	12	Numerical area
5	Informative message area	13	Alarm icon
6	Battery status icon	14	Alarm limit values
7	Patient mode icon	15	Title of numeric parameter
8	Big number screen icon	16	Numeric value

Figure 5. Displays

Table 3. Display Symbols

Symbols	Description	Symbols	Description
ECG	ECG waveform icon	15 min	NIBP auto mode Interval
II	ECG lead pair	10 min	NIBP elapsed time
1mV	ECG size scale	%SpO2	SpO_2 icon and unit
[	ECG size bar		Pulse amplitude indicator
P1	P1 Label	RR/min	Respiration rate icon & unit
P2	P2 Label	Im	Respiration source icon: Im
ABP	P1 or P2 Label: Arterial Blood Pressure	Aw	Respiration source icon: Aw
CVP	P2 Label: Central Venous Pressure		Lung icon
PAP	P2 Label: Pulmonary Artery Pressure	$InCO_2$	$InCO_2$ icon: Inspired carbon dioxide concentration
LAP	P2 Label: Left Atrial Pressure	$EtCO_2$	$EtCO_2$ icon: End-tidal carbon dioxide concentration
PLETH	Plethysmograph icon	T1	Temperature channel 1 icon
CAPNO	Capnograph icon	T2	Temperature channel 2 icon
RESP	Impedance respiration waveform icon	ΔT	Delta T icon |T1-T2|
♥ bpm	HR/PR icon & unit	°C	Temperature unit: Celsius
ECG	HR source icon: ECG	°F	Temperature unit: Fahrenheit
P1	PR source icon: IBP1		Battery status icon
ABP	PR source icon: IBP1		Big number screen icon
SpO2	PR source icon: SpO_2		Setup icon
NIBP	PR source icon: NIBP		Alarm limits icon
NIBP	NIBP icon		Patient mode: Adult
mmHg	NIBP, IBP or $EtCO_2$ unit: mmHg		Patient mode: Neonatal
kPa	NIBP, IBP or $EtCO_2$ unit: kPa	08:12	Time display
%	$EtCO_2$ unit: %	100 90	Alarm limits value
S	Systolic pressure icon		Alarm icon
M	MAP or Mean pressure icon		Audible Alarm silence icon
D	Diastolic pressure icon		Audible Alarm suspend icon

Symbols	Description	Symbols	Description
⋋⊢⋌	NIBP graphical trend icon	□	HR/PR graphical trend icon
△	T2 graphical trend icon	×	SpO_2 graphical trend icon
⊤	T1 graphical trend icon	⊢⊣	IBP graphical trend icon
◇	$EtCO_2$ graphical trend icon	+	Respiration graphical trend icon

Table 4. Display Colors

Function	Color
ECG and HR/PR	Green
Plethysmograph and SpO_2	Cyan
NIBP	Yellow
Respiration	White
Temperature	Pink
Capnograph, $InCO_2$ and $EtCO_2$	Orange
IBP1 (P1 Label)	Purple
IBP2 (P2 Label)	Blue
General background	Black
Informative message	Black background, White font
Low priority alarm message	White background, Black font,
Medium priority alarm message	Yellow background, Black font,
High priority alarm message	Red background, Black font,
Battery status icon (normal)	Green
Battery status icon (low battery)	Yellow or Red (refer to Table 8)

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SETTING UP THE MONITOR

WARNING: To ensure accurate performance and prevent device failure, do not expose the monitor to extreme moisture, including direct exposure to rain. Such exposure may cause inaccurate performance or device failure. Refer to *Specification* section.

WARNING: The monitor should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor should be observed to verify normal operation in the configuration it is to be used.

WARNING: Make sure that the monitor speaker is not obstructed. Failure to do so could result in an inaudible alarm tone.

CAUTION: Recharging the battery is strongly recommended when the battery has not been recharged for 2 or more months.

CAUTION: Follow local government ordinances and recycling instructions regarding disposal or recycling of device components, including batteries.

Unpacking and Inspection

The monitor is shipped in one carton. Examine the carton carefully for evidence of damage. Contact Colin Medical Technology Technical Support Representative immediately if any damage is discovered. Refer to the **Maintenance** section for instructions on returning damaged items.

Note: Refer to **Performance Verification** section in the service manual for the detailed information.

List of Components

The following items are standard in the package.

Table 5. Standard Accessories

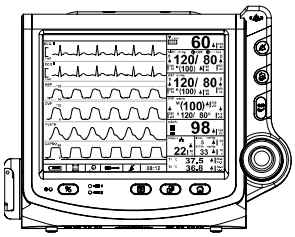
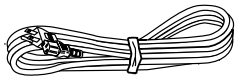
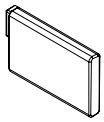
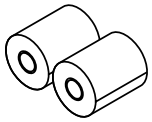
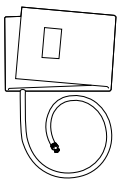
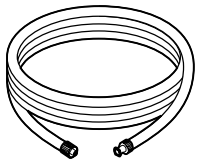
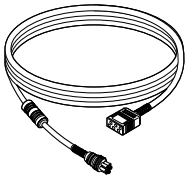
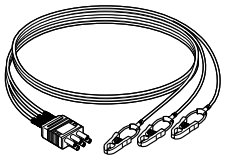
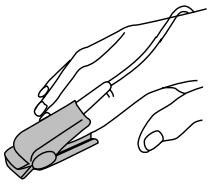
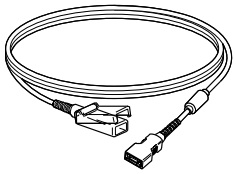
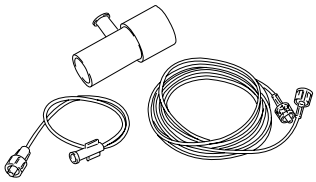
	Figure	Description	REF	Q'ty
Main Unit		BP-S510	-	1
		OPERATION MANUAL (English)	1731064	1
		AC POWER CORD	046111	1
		BATTERY	040074	1
		ROLL PAPER *Only when Recorder option is installed.	-	2
For NIBP		CUFF No.3 (12cm)	A013ZZ	1
		CUFF HOSE No.1 (3.5m)	A015ZZ	1
For ECG		ECG CABLE No.8	AY1005	1

	Figure	Description	REF	Q'ty
For ECG		ECG 3-LEAD WIRES No.5 (G,R,Y)	AG1002	1
For SpO_2		SpO_2 DURA SENSOR DS-100A	-	1
		SpO_2 EXTENSION CABLE DOC-10	-	1
For CO_2		SAMPLING SET (AIRWAY ADAPTER, NAFION TUBE & SAMPLING TUBE) *Only when CO_2 option is installed.	C010ZZ	1

Optional items listed below can be ordered. Contact your local sales supplier for the detailed information.

Table 6. Optional Accessories

	REF	Description	Unit	Min.Qty
NIBP	A012ZZ	CUFF No.2 (9cm)	pce	-
	A014ZZ	CUFF No.4(14cm)	pce	-
	AL021Z	CUFF No.10(2.5cm)	pce	10
	AL022Z	CUFF No.11(3cm)	pce	10
	AL023Z	CUFF No.12(4cm)	pce	10
	AL024Z	CUFF No.13(5cm)	pce	10
	A016ZZ	CUFF HOSE No.2(1.5m)	pce	-
	AL012Z	CUFF HOSE No.3(3.5m)	pce	-
ECG	AG006Z	ECG ELECTRODES 25pcs/bag	bag	1
	AG1003	ECG 5-LEAD WORES No.6(G,R,Y,W,B)	pce	-
SpO_2	-	ADULT FINGER OXISENSOR MAX-A	-	-
	-	CHILD FINGER OXISENSOR MAX-P	-	-
	-	NEONTAL OXISENSOR MAX-N	-	-
	-	INFANT OXISENSOR MAX-I	-	-
	-	ADULT NASAL OXISENSOR MAX-R	-	-
	-	MAX-FAST	-	-
CO_2	C005ZZ	WATER TRAP	-	-
	C003ZZ	NAFION TUBE	pce	10
	C004ZZ	SAMPLING TUBE	pce	10
	C002ZZ	AIR WAY ADAPTER	pce	10
IBP	AS012Z	IBP DISPOSABLE TRANSDUCER DT-12	pce	10
	AS011Z	IBP DISPOSABLE TRANSDUCER DT-4812	pce	10
	046432	IBP INTERFACE CABLE TC-COL-2	pce	1
TEMP	AS004Z	BT Sensor Model 401J/Rectum, Gullet (produced by YSI)	pce	1
	AS005Z	BT Sensor Model 402J/Rectum, Gullet/Small(produced by YSI)	pce	1
Others	1731064A	OPERATION MANUAL (English)	pce	1
	1731065A	OPERATION MANUAL (German)	pce	1
	1731066A	OPERATION MANUAL (French)	pce	1
	1731093A	OPERATION MANUAL (Portugese)	pce	1
	1731068A	OPERATION MANUAL (Spanish)	pce	1
	1731071A	SERVICE MANUAL (English)	pce	1
	040074	BATTERY (BP-S510)	-	-
	048151	ROLL PAPER BP-S510	-	-
	A023ZZ	GROUDING WIRE TYPE1	pce	1
	A024ZZ	GROUDING WIRE TYPE2	pce	1

Power Cable Connections

WARNING: Do not connect to an electrical outlet controlled by a wall switch because the device may be accidentally turned off.

CAUTION: If in doubt the integrity of the AC power source, the monitor must be operated from its internal battery.

AC Power

Make sure that the AC outlet is properly grounded and supplies the specified voltage and frequency (100-240V~ 50-60 Hz).

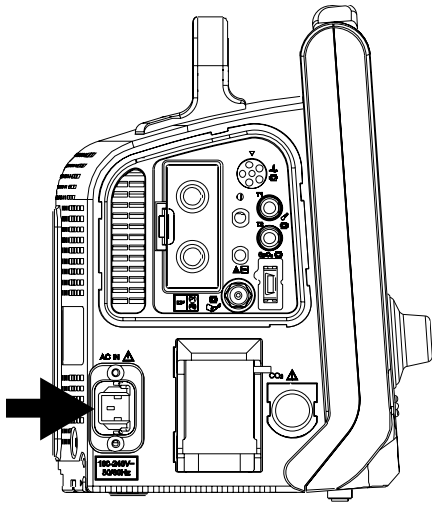


Figure 6. AC Power connection

1. Connect the female connector end of the AC power cord to mains connector on the monitor's left panel.
2. Plug the male connector end of the AC power cord into a properly grounded mains outlet.
3. If necessary, connect grounding wire. Connect the grounding wire connector to the equipotential terminal on the rear panel. Now attach the clip end of the grounding wire to the medical equipment grounding terminal on the wall.
4. Verify that ***Battery charging indicator*** on the monitor's front panel is lit.

Note: Even if the monitor is not turned on, the ***Battery charging indicator*** is lit when the AC power cord is connected into a mains outlet.

Note: If ***Battery charging indicator*** is not lit, check:

- the power cord
- the AC power inlet
- the power/ mains outlet
- No Battery

If the ***Battery charging indicator*** still is not lit although any problem is not found, contact qualified service personnel or your local supplier for assistance.

Measurement Cable Connections

WARNING: For best product performance and measurement accuracy, use only accessories supplied or recommended by Colin Medical Technology. Use accessories according to the manufacturer's directions for use and your facility's standards. Use only accessories that have passed the recommended biocompatibility testing in compliance with ISO10993-1.

Note: Both frequent checks by the operator on daily basis and more comprehensive technical checks less frequently are covered by this requirement in order to detect mechanical damage and damage to cables, etc.

ECG Cables and Leads

1. Connect an ECG cable to the "ECG" connector making sure that the connector arrow is pointing panel.
2. Attach the ECG lead wire to the end of the cable. (see Figure 3)

NIBP Hoses and Cuffs

1. Select an appropriate size cuff for the patient. (Refer to the **NIBP Monitoring** section.)
2. Connect the hose to the "CUFF" connector making sure to tighten the connector in the clockwise direction.
3. Attach the cuff to the end of the hose. (see Figure 3)

SpO_2 Cables and Sensors

1. Select an appropriate sensor for the patient and desired application. (Refer to the **SpO_2 Monitoring** section.)
2. Connect the extension cable DOC-10 to the "SpO_2" connector on the monitor's left panel.
3. Attach the sensor to the end of the cable. (see Figure 3)

Temperature Probes

1. Select the appropriate probe(s) for the desired application.(YSI 400 Series)
2. Connect the temperature probes to the "T1" and/or "T2" connector on the monitor's left panel. (see Figure 3)

IBP Transducers (option)

1. Connect the interface cable(s) for the transducer(s) to the IBP connector on the monitor's left panel. An interface cable for the transducer has to be selected correctly as it depends on the transducer type. (see Figure 3)
2. Set up the patient circuit according to the directions for use of the transducer, monitoring kit and IV set.

CO_2 Sampling set (option)

1. Connect a sampling tube to the "Water Trap" port on the monitor's left panel. (see Figure 3)
2. Connect the nafion tube to the sampling tube.
3. Connect the nafion tube to the airway adaptor.

Note: If lead wires/cables, cuffs/hose cables, sensors and/or probes are not connected firmly, the monitor could lose signals from the patient.

BATTERY OPERATION

CAUTION: Recharging battery is strongly recommended when it has not been fully recharged for 2 or more months.

CAUTION: When the voltage of the battery is very low, it is a possibility of not operating.

Note: It is recommended that the monitor remain connected to AC power source when not in use. This will ensure a fully charged battery whenever it is needed.

Note: As the battery is used and recharged over a period of time, the amount of time between the onset of the low battery alarm and the instrument shut-off may become shorter.

Operating the Monitor on Battery Power

The monitor has an internal battery that can be used to power the monitor when AC power source is not available. The battery status icon appears on the screen when the monitor is on battery power.

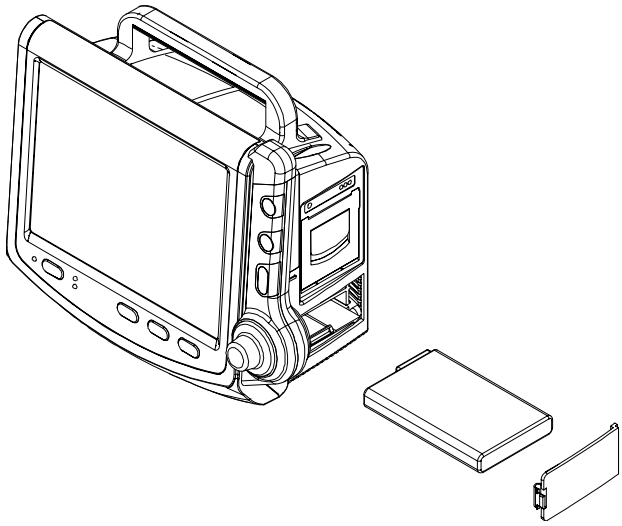


Figure 7. Battery Placement

1. Turn off the monitor.
2. Open the battery cover by pressing the latch.
3. Insert the battery carefully.

Table 7. Front panel Indications for power source

Power Connections	Front panel Indications
AC source	Battery charging indicator is lit.
Battery	Battery status icon appears on the screen.

The monitor cannot operate with a fully discharged battery. Before turning on the monitor with the battery that has been completely discharged, first plug the monitor into an AC outlet to charge the battery for minimum 3 minutes. The monitor may then be powered on.

A new, fully charged battery will provide 1 hour monitoring operation under the following conditions:

- Operation of ECG, Respiration, SpO_2, Temperature, CO_2 and IBP
- NIBP automatic measurement per 5 minutes
- No audible alarm condition
- No external communication operating
- No printing
- Ambient temperature at 25°C

Battery Status Indication

When operating on batteries, the battery status icon in the lower part of the display indicates the battery charge condition. See Table 8.

Table 8. The Monitor Battery Status Icon

Battery Status Icons	Battery Status Icon Color
	Green (constant)
	Yellow (constant) ≤ 15 minutes
	Red (flashing) ≤ 5 minutes

A low priority alarm occurs when the remaining battery power is only enough for 15 minutes of operation. The alarm message ***'Low Battery'*** appears on the screen and the visual alarm indicator is lit with yellow.

This alarm cannot be silenced while running on battery power. Connecting the monitor to AC power will silence the alarm.

A high priority alarm occurs for about 5 minutes before the monitor shuts off. The alarm message '***Critically Low-Battery Condition***' will appears and the visual alarm indicator will flash with red. After that, the monitor will automatically shut down. Connect the monitor to an AC power source to avoid any loss of trend data or settings.

Charging a Low Battery

1. Connect the monitor to AC power source to charge a low or depleted battery. (see the **Setting up the Monitor** section)
2. Verify that ***Battery charging indicator*** is lit with orange.

Table 9. Front Panel Indications for Battery Status

Battery status	Battery charging indicator
Full charged	Green
Charging	Orange
Not installed	Off

Note: Even if the monitor is turned off, ***Battery charging indicator*** is lit while the battery is recharged.

Note: A full charge of a depleted battery takes over 12 hours per battery.

USING THE MONITOR

WARNING: If the Power On Self-Test is not completed successfully, do not try to use the monitor.

WARNING: Each time the monitor is used, check alarm limits to make sure that they are appropriate for the patient being monitored.

WARNING: Keep patients under close surveillance when monitoring. It is possible, although unlikely, that radiated electromagnetic signals from sources external to the patient and the monitor can cause inaccurate measurement readings. Do not rely entirely on the monitor readings for patient assessment.

Turning on the Monitor

Before using the monitor, confirm that the monitor is working properly and is safe to use as described below.

CAUTION: When power is applied, the monitor automatically starts the Power-On Self-Test (POST), which tests the monitor circuitry and functions. During POST, confirm that the monitor screen turns on. If the monitor screen does not function properly, do not use the monitor. Instead, contact qualified service personnel or your local supplier.

Note: The post test tone sounds when the monitor completes the Power-On Self-Test (POST). This functions as an audible confirmation that the speaker is performing properly. If the speaker does not function, the alarm warning sounds cannot be heard.

Note: If there is any problem on the speaker during the operation, the buzzer generates the sound automatically to alert the user to notice the speaker failure. If unusable sound like buzzer can be heard, do not use the monitor. Instead, please contact qualified service personnel or your local supplier.

1. Turn on the monitor by pressing ***Power on/off button***. Confirm that the ***Power on indicator*** on the monitor's front panel is lit.
2. After the checksum for flash memory is completed, the monitor performs POST. The initial screen appears during POST. The initial screen displays the company logo, the version of system and the current time.
3. If there is no error, all indicators are lit for at least 2 seconds and the post pass tone sounds during POST. Confirm that the post pass tone sounds and all indicators are lit during POST.

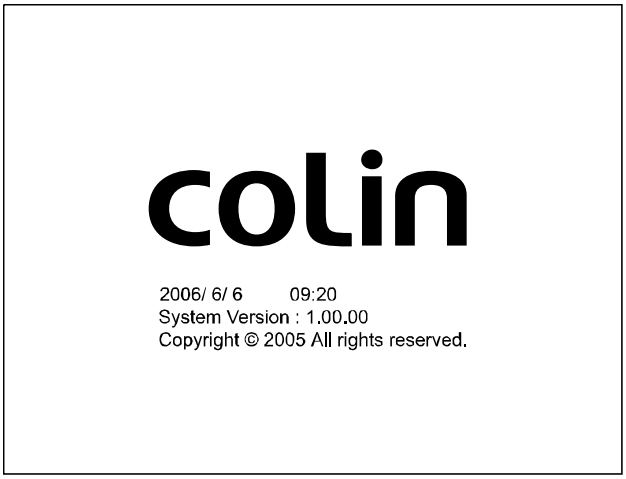


Figure 8. Initial Screen

Note: The system version shown above is only an example.

4. After power-up diagnostics are successfully completed, the monitor is ready for operation.

Note: If the monitor detects an internal problem during POST, the monitor will display an error code and will not display the monitoring screen. If an error code is displayed during POST, contact qualified service personnel or your local supplier for assistance.

5. When the monitor detects valid signals, it displays real-time waveforms similar to Figure 9.

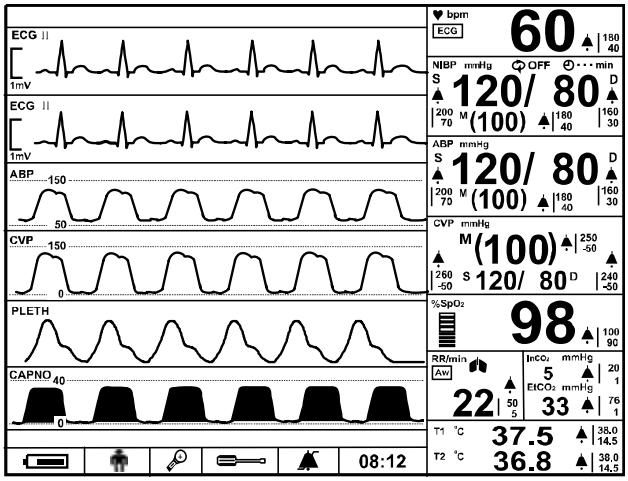


Figure 9. Typical Screen during monitoring

Setting Date and Time

You may set the date and time displayed on the screen and printed on the reports.

1. Rotate the jog dial to highlight ***Time display***, and then press the jog dial to select ***Date/Time menu***.
2. Rotate the jog dial to display the desired number for year, month, day, hour or minute, and then press the jog dial to select the desired number.

Note: The time format is 24 hours only. The date format can be set via ***Service menu***.

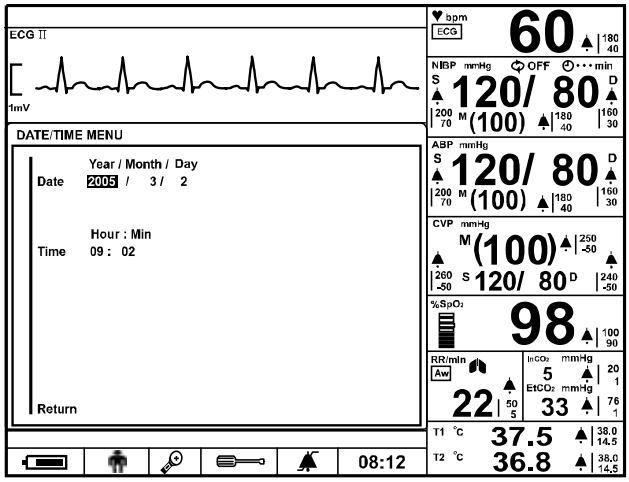


Figure 10. Date/Time Menu

Table 10. Date/Time Menu

Level 1 Menu	Level 2 Menu or Response
DATE/TIME MENU	
Date	Year
	Month
	Day
Time	Hour
	Min
Return	

Setting Basic Setup Parameters

This procedure will allow you to set Patient Mode, Record Speed, Wave Record Time, Wave Record Select, Record On Alarm, Auto List Record, Alarm Volume, HR/PR Tone Volume, Key Beep Volume, Sleep Mode, Main Screen and Service menu.

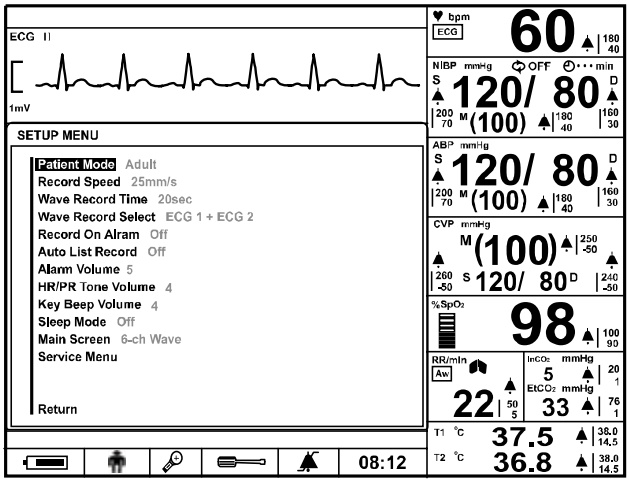


Figure 11. Setup Menu

Table 11. Setup Menu

Level 1 Menu	Level 2 Menu or Response
SETUP MENU	
Patient Mode	Adult, Neonatal
Record Speed*	25.0mm/s, 50.0mm/s
Wave Record Time*	20 sec, Continuous
Wave Record Select*	ECG 1 + ECG 2
	ECG 1 + PLETH
	ECG 1 + RESP
	ECG 1 + (P1 Label)
	ECG 1 + (P2 Label)
	ECG 1 + CAPNO
Record On Alarm*	On, Off
Auto List Record*	On, Off
Alarm Volume	1, 2, 3, 4, 5, 6, 7, 8
HR/PR Tone Volume	Off, 1, 2, 3, 4, 5, 6, 7
Key Beep Volume	Off, 1, 2, 3, 4, 5, 6, 7
Sleep Mode	Off, 10, 20, 30 minutes
Main Screen	4-ch Wave, 6-ch Wave, Big Number
Service Menu	(Pass code required)
Return	

Note: The menu options followed by an asterisk (*) are only displayed with an optional recorder installed.

Note: If there is no activity for 20 seconds, the monitor will return to main screen.

Patient Mode

1. Rotate the jog dial to highlight ***Setup icon***. Press the jog dial to display the setup menu.
2. Rotate the jog dial to highlight ***Patient Mode***, and then press the jog dial to select an appropriate mode: Adult or Neonatal.

Setting Record

If an optional recorder is installed, this menu will allow you to set ***Record Speed***, ***Wave Record Time, Wave Record Select, Record On Alarm*** and ***Auto List Record***. Refer to the **Printing** section for details.

Note: These menus are grayed out if no recorder installed in the monitor.

Setting Volume

Setting ***Volume*** allows you to adjust an audible alarm volume, Key beep volume and HR/PR tone volume. ***Alarm volume*** can be set level 1 to 8 and ***Key beep volume*** and ***HR/PR tone volume*** can be set level 1 to 7 or Off. (see Alarms and Limits section)

1. Rotate the jog dial to highlight ***Alarm volume, Key beep volume*** or ***HR/PR tone volume***.
2. Press the jog dial. Levels of ***Alarm volume, Key beep volume*** or ***HR/PR tone volume*** will appear.
3. Rotate the jog dial to select a volume level. (see each volume level in the Table 11).
4. Press the jog dial to enter a desired volume into the monitor.

Sleep Mode

The monitor can be set to sleep mode for saving the power. The back light of the screen is turned on continuously when ***Off*** is selected, When ***10 min, 20 min*** or ***30 min*** is selected, the back light of the screen will be turned off automatically after the selected time if there is not any alarm condition and control by the user.

Setting Main Screen

You may select the number of the waveforms to be displayed; ***4-ch wave***, ***6-ch wave*** or ***Big number***.

The following are the default screens of waveforms and big numbers as per each configuration.

✓ 4-ch wave with basic configuration: ECG 1 + ECG 2 + SpO_2 + RESP

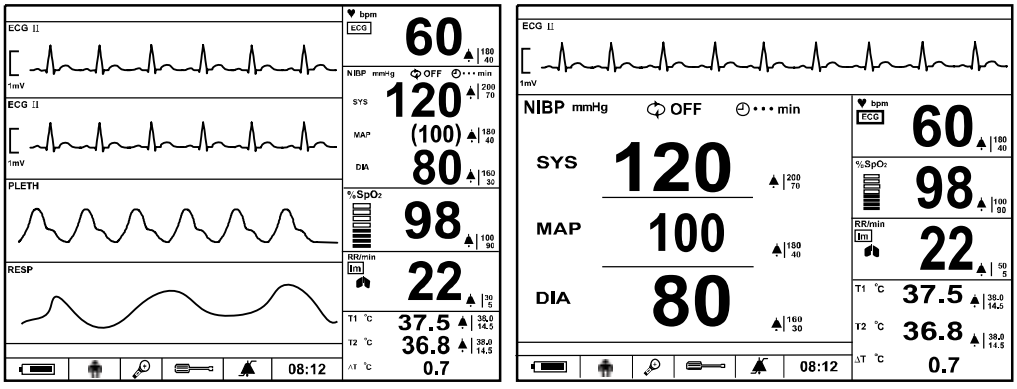


Figure 12. Basic configuration display

✓ 6-ch wave with CO_2 option: ECG 1 + ECG 2 + ECG 3 + SpO_2 + RESP + CAPNO

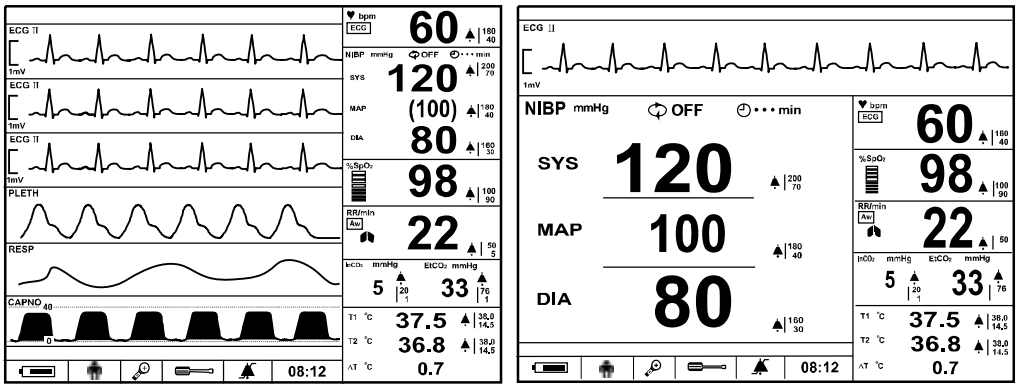


Figure 13. CO_2 option display

✓ 6-ch wave with IBP option: ECG 1 + ECG 2 + IBP 1 + IBP 2 + SpO_2 + RESP

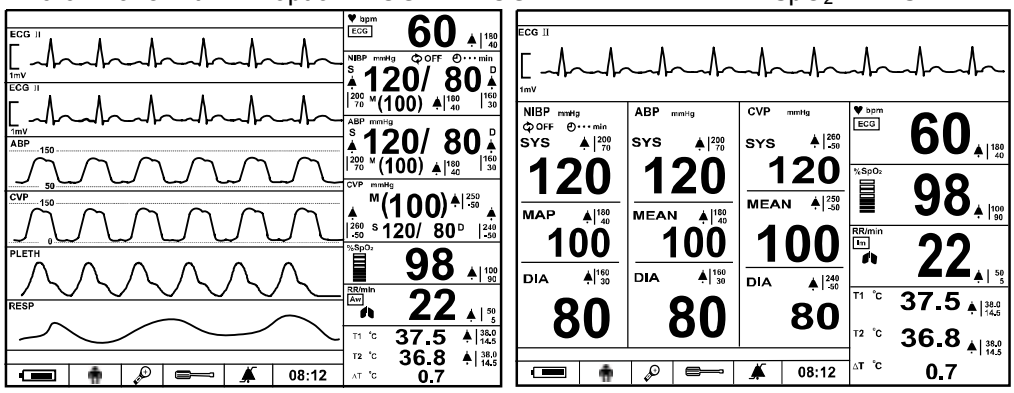


Figure 14. IBP option display

✓ 6-ch wave with IBP&CO_2 option: ECG 1 + ECG 2 + IBP 1 + IBP 2 + SpO_2 + CAPNO

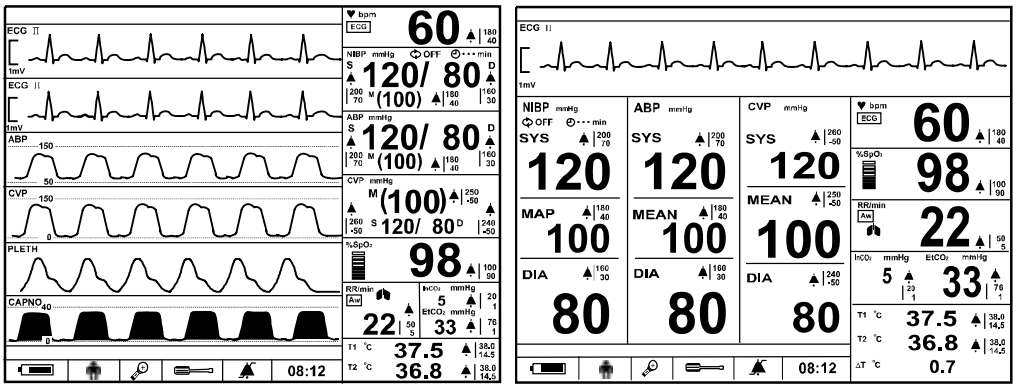


Figure 15. IBP and CO_2 option display

Note: The user can select a desired waveform in each waveform area.

1. Rotate the jog dial to highlight the waveform area to be changed.
2. Press the jog dial to display the waveform menu.
3. Select ***Waveform select*** by rotating and pressing the jog dial.
4. Select the desired waveform by rotating and pressing the jog dial.

Note: The monitor can display ***Big Number Screen*** by selecting ***Big number icon*** and return to the main screen by selecting ***Big number icon*** again.

Note: The menus can be accessed in ***Big Number Screen*** without returning the main screen.

Note: When an alarm condition occurs, the visual or audible alarm is activated in ***Big Number Screen.***

Service Menu

This menu includes Save Settings on Power off, Audible Alarm Silence Period, Audible Alarm Suspend Period, Audible Alarm Type, AC Line Frequency, Unit Configuration, Language Setting, Date Format, Jog Dial Speed, LAN Setting, System Setting, System Test, NIBP Test and Demo Mode. Only authorized personnel is allowed to change the ***Service Menu*** settings. A pass code is required for access. Refer to the service manual for instructions.

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ALARMS AND LIMITS

WARNING: Each time the monitor is used, check alarm limits to make sure that they are appropriate for the patient being monitored.

General

When the monitor detects certain conditions that require user attention, the monitor enters an alarm state. The monitor response is indicated by:

- Visual alarm indication
- Audible alarm indication
- Physiological alarms including identification of out-of-limit vital signs
- Technical alarms

Note: The audible and visual alarms on the monitor, used in conjunction with clinical signs and symptoms, are the primary source for notifying medical personnel that a patient alarm condition exists.

Changing Alarm Volume

You can select an alarm volume level 1 to 8. Refer to the **Using the Monitor** section (see Figure 11, Table 11).

Taking an NIBP Measurement on Alarm

You can activate BP on Alarm via ***NIBP menu***. Refer to the **Using the Monitor** section.

Initiating Print out on Alarm (Only when recorder option is installed)

You can activate Record on Alarm via ***Setup menu***. Refer to the **Printing** section.

Alarm Priority and Messages

There are three possible priorities for visual and audible alarms: High, Medium, and Low. The high, medium and low priority messages are displayed in the alarm message area, and the informative messages are displayed in the informative message area. Refer to the **Troubleshooting** section for the recommended actions.

High Priority

Table 12. High Priority Alarm

Physiological Alarm		
Parameter	**Condition**	**Messages**
NIBP	Over the systolic BP upper limit	NIBP: SYS upper limit violated.
	Under the systolic BP lower limit	NIBP: SYS lower limit violated.
	Over the diastolic BP upper limit	NIBP: DIA upper limit violated.
	Under the diastolic BP lower limit	NIBP: DIA lower limit violated.
	Over the map BP upper limit	NIBP: MAP upper limit violated.
	Under the map BP lower limit	NIBP: MAP lower limit violated.
ECG	Cardiac arrest	ECG: Asystole.
HR/PR	Over the heart rate upper limit	HR: Upper limit violated.
	Under the heart rate lower limit	HR: Lower limit violated.
	Over the pulse rate upper limit	PR(*{source}*): Upper limit violated.
	Under the pulse rate lower limit	PR(*{source}*): Lower limit violated.
Resp	Respiration signal is not detected during 40sec.	Resp: Loss of respiration signal.
	Over the respiration rate upper limit	Resp: Upper limit violated.
	Under the respiration rate lower limit	Resp: Lower limit violated.
IBP	Over the systolic upper limit	*{label}*: SYS upper limit violated.
	Under the systolic lower limit	*{label}*: SYS lower limit violated.
	Over the diastolic upper limit	*{label}*: DIA upper limit violated.
	Under the diastolic lower limit	*{label}*: DIA lower limit violated.
	Over the mean upper limit	*{label}*: MEAN upper limit violated.
	Under the mean lower limit	*{label}*: MEAN lower limit violated.
%SpO_2	Over the %SpO_2 upper limit	SpO_2: Upper limit violated.
	Under the %SpO_2 upper limit	SpO_2: Lower limit violated.
Temp	Over the temperature upper limit	Temp*{n}*: Upper limit violated.
	Under the temperature lower limit	Temp*{n}*: Lower limit violated.
Capno	Incapable of detecting respiration for certain period (set).	Capno: Apnea.
	Over the $EtCO_2$ upper limit	$EtCO_2$: Upper limit violated.
	Under the $EtCO_2$ lower limit	$EtCO_2$: Lower limit violated.
	Over the $InCO_2$ upper limit	$InCO_2$: Upper limit violated.
	Under the $InCO_2$ lower limit	$InCO_2$: Lower limit violated.

Technical Alarm		
Parameter	**Condition**	**Messages**
NIBP	Inflation doesn't finish with specified time. Specified time is 30 sec for adult and 20 sec for neo. (C11)	NIBP: Check cuff (C11)
	Measurement value can't be calculated even when inflated cuff pressure is deflated to specified pressure. Specified pressure is 10mmHg for adult and 5 mmHg for neo. (C12)	NIBP: Check cuff / Patient (C12)

Technical Alarm		
Parameter	**Condition**	**Messages**
NIBP	Deflation time is too long Deflation speed is too low (C13)	NIBP: Cuff excessive artifact (C13)
	Maximum inflating pressure is too low to calculate patient BP value. (C14)	NIBP: Cuff insufficient pressure (C14)
	Abnormal pulse due to arrhythmia and too much noise. (C15)	NIBP: Cuff irregular pulses (C15)
	Collected pulse's movement is abnormal. (C16)	NIBP: Cuff motion artifact (C16)
	Measurement time is beyond specified time. Specified time 160sec for adult and 80sec for neo. (C17)	NIBP: Cuff time-out (C17)
	Number of detected pulses is beyond specified number. Specified number is 160 for both adult and neo. (C18)	NIBP: Cuff time-out, over 160 pulses (C18)
	Cuff pressure is beyond the pressure specified for the patient safety. Specified pressure is 300mmHg for adult and 150mmHg for neo. (C19)	NIBP: Cuff pressure failure (C19)
	The maximum value of collected pulse is too low. (C20)	NIBP: Cuff weak pulse (C20)
	Cuff size is inadequate to patient. (C21)	NIBP: Check cuff, hose and mode (C21)
	NIBP module error BPM pressure sensor fault. Pump operated for ten seconds, however pressure does not change. Check the connection of the cuff hose.	NIBP: Internal error (E03)
	NIBP module error	NIBP: Internal error (E07)
	NIBP module error	NIBP: Internal error (E08)
	NIBP module error Fault detected in accordance with safety monitoring to BPM IEC standards. The pressure inside the cuff reaches the standard pressure, Standard pressure Adult: 320mmHg Neonatal: 157mmHg	NIBP: Internal error (E09)
	NIBP module error	NIBP: Internal error (ROM)
	NIBP module error	NIBP: Internal error (RAM)
	NIBP module error	NIBP: Internal error (COM)
ECG	ECG module problem.	ECG: Internal error.
Resp	RESP module problem.	Resp: Internal error.
IBP	IBP signal is not detected.	*{label}*: Loss of pulse.
	IBP module problem.	IBP: Internal error.
%SpO_2	SpO_2 signal is not detected.	SpO_2: Loss of pulse.
	SpO_2 module problem.	SpO_2: Internal error.
Temp	Temperature module problem.	TEMP*{n}*: Internal error.
Capno	Capno module have problem.	Capno: Internal error.
	CO_2 sensor error	Capno: Sensor error.

Technical Alarm		
Parameter	**Condition**	**Messages**
System	Critically low battery condition. The device will be automatically turned off within 5 minutes.	System: Critically low-battery condition.
	Real time clock is malfunction.	System: Real time clock error.
	Watch dog timer is malfunction.	System M: WDT error.
	Data memory is broken.	System M: RAM error.
	Manufacturer use	System: Failure.

Medium Priority

Table 13. Medium Priority Alarm

Technical Alarm Message		
Parameter	**Condition**	**Messages**
ECG	Patient lead of cable disconnected.	ECG : Check ECG leads & electrodes.
IBP	Transducer or interface cable is disconnected.	*{label}*: Cable/Sensor disconnected.
%SpO_2	Sensor or cable is disconnected.	SpO_2: Check probe.
Temp	Temperature probe is disconnected.	Temp*{n}*: Temperature probe disconnected.
Capno	Occlusion alarm.	Capno: Occlusion.
	Water trap full alarm.	Capno: Water trap full.

Low Priority

Table 14. Low Priority Alarm

Technical Alarm Message		
Parameter	**Condition**	**Messages**
ECG	ECG signal is saturated.	ECG: Signal saturation.
Resp	Patient lead of cable disconnected.	Resp: Check Resp leads & electrodes.
IBP	Failed in zero calibration.	*{label}*: Unable to zero calibration.
	In case of following BP value -100 ≤ IBP ≤ -55, 330 ≤ IBP [mmHg]	*{label}*: Out of range.
%SpO_2	Sensor disconnected from patient	SpO_2: Check sensor.
	The sensor is broken down or defected.	SpO_2: Sensor failure.
	Module is reset during operation.	SpO_2: Module reset.
Temp	In case following temperature 14.0 ≤ T ≤ 45.0 ºC	Temp*{n}*: Out of range.
Capno	Failed in calibration	Capno: Zero calibration range error
		Capno: Zero calibration signal unstable error
		Capno: High calibration range error
		Capno: High calibration signal unstable error
System	Low Battery, The device will be automatically turned off within 15 minutes.	System: Low battery.

Informative Messages

Informative messages indicate a system condition that needs to be corrected.

Table 15. Informative Messages

Parameter	Condition	Messages
NIBP	Measurement value can't be calculated even when inflated cuff pressure is deflated to specified pressure. Specified pressure is 10mmHg for adult and 5 mmHg for neo. (C12)	NIBP: Retry, Check cuff/Patient (C12)
	Deflation time is too long Deflation speed is too low. (C13)	NIBP: Retry, Cuff excessive artifact (C13)
	Maximum inflating pressure is too low to calculate patient BP value. (C14)	NIBP: Retry, Cuff insufficient pressure (C14)
	Abnormal pulse due to arrhythmia and too much noise. (C15)	NIBP: Retry, Cuff irregular pulses (C15)
	Collected pulse's movement is abnormal. (C16)	NIBP: Retry, Cuff motion artifact (C16)
	Number of detected pulse is beyond specified number. Specified number is 160 for both adult and neo. (C18)	NIBP: Retry, Cuff time-out, over 160 pulses (C18)
	Cuff pressure is beyond specified pressure that is specified for patient safety. Specified pressure is 300mmHg for adult and 150mmHg for neo. (C19)	NIBP: Retry, Cuff pressure failure (C19)
	Cuff size is inadequate to patient. (C21)	NIBP: Retry, Check cuff, hose and mode (C21)
ECG	Pacer pulse detection is on.	ECG: Pacer detect is on.
IBP	Waiting for zero calibration.	*{label}*: No zero reading.
	Zero calibration in progress.	*{label}*: Zero CAL in progress.
%SpO_2	Current measurement is affected by patient motion.	SpO_2: Motion artifact.
	On pulse searching	SpO_2: Pulse search in progress.
Capno	Messages about Zero calibration process	Capno: Calibration in progress.
		Capno: Turn on CO_2(10%) calibration gas.
		Capno: Turn off CO_2(10%) calibration gas.
		Capno: Calibration gas detected.
	Capno module is warming up.	Capno: Warming up in progress.
System	Recorder has no paper.	System: No recorder paper.
	Device abnormally shut down last time	System: Abnormally shut down last time.
	Device has no recorder module.	System: No recorder installed.
Other	Alarm sound is silenced.	Audible alarm silenced.
	Alarm sound is suspended.	Audible alarm suspended.
	Alarm sound is inhibited.	Audible alarm inhibited.
	Device in Demo Mode	Demo Mode.
	Exit scrolling in trend screens	Press jog dial to exit scroll.
	Contact your service personnel.	Contact your service personnel.

Note: There may be other informative messages that are not listed above.

Visual Alarm Indication

Table 16. Visual Alarm Characteristics

Alarm Category	Color	Alarm Indicator Flashing Rate
High priority	Red	5 flashes in 3 seconds (1.7Hz)
Medium priority	Yellow	5 flashes in 8 seconds (0.6Hz)
Low priority	Yellow	Always on (non-flashing)

Note: ***Visual alarm Indicator*** on the right top of the front panel responds with the flashing rates described in Table 16 when an alarm occurs.

When the **high priority alarm** is activated, a non-flashing alarm message is displayed. The numerical area will flash red.

When a **medium priority alarm** is activated, a non-flashing alarm message is displayed. The numerical area will flash yellow.

When a **low priority alarm** activated, a non-flashing alarm message is displayed. The numerical area will change to yellow.

Audible Alarm Indication

WARNING: Do not silence the audible alarm or decrease its volume if patient safety could be compromised.

WARNING: Make sure that the monitor speaker is not obstructed. Failure to do so could result in an inaudible alarm tone.

Table 17. Audible Alarm Characteristics

Alarm Category	Tone Pitch	Beep Rate
High priority	High	10 beeps in 10 seconds (976Hz)
Medium priority	Medium	3 beeps in 16 seconds (697Hz)
Low priority	Low	Non-beep

Note: Audible alarms may be decreased in volume as described in Table 11 or temporarily silenced.

Verifying Visual and Audible Alarm Indication

If the monitor fails to perform as specified in this test, contact qualified service personnel or Mediana Technical Support Representative for assistance.

You can verify the alarm operation for all parameters like ECG, SpO_2, NIBP, Temp, and RESP by following the below procedures.

1. Connect the monitor to an AC power source.
2. Press ***Power button*** to turn on the monitor.
3. Connect the simulator to sensor input cable and connect cable to monitor.
4. Set the simulator to smaller value than the lower alarm limit on the monitor.
5. Verify following the monitor reaction:

a. The monitor begins to track the physiological signal from the simulator.

b. After about 10 to 20 seconds, the monitor displays the value measured as specified by simulator. Verify values are within the tolerances specified in **Specification** section for each parameter (ECG, SpO_2, NIBP, Temp, RESP, IBP, $EtCO_2$).

c. Audible alarm sounds.

d. Visual alarm Indicator on the front panel flashes.

e. "***Lower limit violated***" message is displayed.

f. The numerical area flashes, indicating the parameter has violated default alarm limits.

Changing Alarm Limits

WARNING: Each time the monitor is used, check alarm limits to make sure that they are appropriate for the patient being monitored.

You can change alarm limits from default values, if necessary.

Alarm limits or Alarm suspension may be set in two ways:

- Via interaction with ***HR/PR, SpO_2, NIBP, Respiration, Temperature, CO_2*** and ***IBP menu***
  or
- Via interaction with ***Alarm limits menu*** that presents the limits in all the parameters at one time

Setting Alarm Limits via Alarm Limits Menu

1. Rotate the jog dial to highlight ***Alarm limits icon*** on the lower of the screen, then press the jog dial to display ***Alarm limits menu***

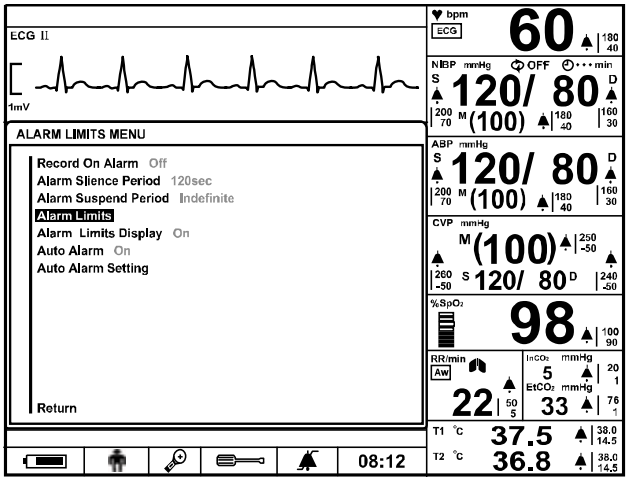


Figure 16. Alarm Limits Menu

2. Press the jog dial to select ***Alarm limits***. The monitor will display all alarm limits that are currently in effect for all monitored parameters. Select the alarm limits to set.

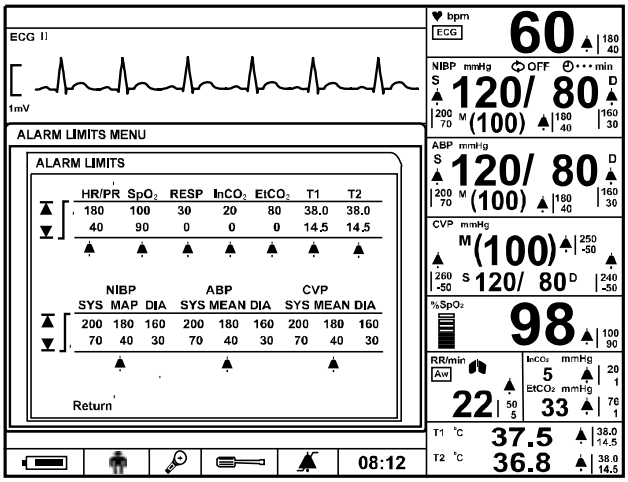


Figure 17. Alarm Limits Setting

Table 18. Alarm Limits Menu

Level 1 Menu	Level 2 Menu or Response
ALARM LIMITS MENU	
Record on Alarm	On, Off
Audible Alarm Silence Period	(30, 60, 90, 120 seconds)
Audible Alarm Suspend Period	(Off,10, 20, 30, 60 minutes, Indefinite)
Alarm Limits	HR/PR, NIBP (SYS, DIA, MAP), RESP, SpO_2 P1 (SYS, DIA, MAP), P2 (SYS, DIA, MAP) $InCO_2$, $EtCO_2$, T1, T2
	Alarm Suspend for each parameter
Alarm Limits Display	On, Off
Auto Alarm	On, Off
Auto Alarm Setting	% Setting for each parameter
Return	

Note: Record on Alarm can be only set via ***Setup menu***.

Note: Audible alarm silence period and audible alarm suspend period can be only set via ***Service menu***.

Alarm Limits Ranges

Table 19 describes the possible alarm limits. The monitor is shipped with factory default settings.

Note: Authorized personnel can define the way to save the settings upon power off: custom, backup and default. The detailed information is described in the service manual.

Table 19. Alarm Limits Ranges

Parameters	Upper Limit, Default	Lower Limit, Default	Resolution
HR/PR (BPM)			
Adult	35 ~ 305 BPM, 180 BPM	30 ~ 300 BPM, 40 BPM	5 BPM
Neonatal	35 ~ 305 BPM, 200 BPM	30 ~ 300 BPM, 50 BPM	5 BPM
NIBP Systolic (mmHg, kPa)			
Adult	60 ~ 260 mmHg, 200 mmHg (8.0 ~ 34.7 kPa, 26.7 kPa)	50 ~ 250 mmHg, 70 mmHg (6.7 ~ 33.3 kPa, 9.3 kPa)	10 mmHg (1.3 kPa)
Neonatal	40 ~ 130 mmHg, 130 mmHg (5.3~ 17.3 kPa, 17.3 kPa)	30 ~ 120 mmHg, 50 mmHg (4.0 ~ 16.0 kPa, 6.7 kPa)	10 mmHg (1.3 kPa)
NIBP Diastolic (mmHg, kPa)			
Adult	40 ~ 210 mmHg, 160 mmHg (5.3 ~ 28.0 kPa, 21.3 kPa)	30 ~ 200 mmHg, 30 mmHg (4.0 ~ 26.7 kPa, 4.0 kPa)	10 mmHg (1.3 kPa)
Neonatal	20 ~ 100 mmHg, 100 mmHg (2.7 ~ 13.3 kPa, 13.3 kPa)	10 ~ 90 mmHg, 10 mmHg (1.3 ~ 12.0 kPa, 1.3 kPa)	10 mmHg (1.3 kPa)
NIBP MAP (mmHg, kPa)			
Adult	50 ~ 240 mmHg, 180 mmHg (6.7 ~ 32.0 kPa, 24.0 kPa)	40 ~ 230 mmHg, 40 mmHg (5.3 ~ 30.7 kPa, 5.3 kPa)	10 mmHg (1.3 kPa)
Neonatal	30 ~ 110 mmHg, 110 mmHg (4.0 ~ 14.7 kPa, 14.7 kPa)	20 ~ 100 mmHg, 20 mmHg (2.7 ~ 13.3 kPa, 2.7 kPa)	10 mmHg (1.3 kPa)
SpO_2 (%)			
Adult	70 ~ 100 %, 100 %	69 ~ 99 %, 90 %	1 %
Neonatal	70 ~ 100 %, 100 %	69 ~ 99 %, 85 %	1 %
Respiration (BPM)			
Adult	5 ~ 155 BPM, 30 BPM	0 ~ 150 BPM, 0 BPM	5 BPM
Neonatal	5 ~ 155 BPM, 50 BPM	0 ~ 150 BPM, 0 BPM	5 BPM
Temperature (°C, °F)			
Adult	15.0 ~ 45.5°C, 38.0 °C (59.0 ~ 113.9°F, 100.4°F)	14.5 ~ 45.0 °C, 14.5 °C (58.1 ~ 113°F, 58.1°F)	0.5°C (0.9°F)
Neonatal	15.0 ~ 45.5 °C, 39.0 °C (59.0~ 113.9°F, 102.2°F)	14.5 ~ 45.0 °C, 14.5 °C (58.1 ~ 113°F, 58.1°F)	0.5°C (0.9°F)
$EtCO_2$ (mmHg, kPa, %)			
Adult	2 ~ 80 mmHg, 80 mmHg (0.3 ~ 10.7 kPa, 10.7 kPa) (0.3 ~ 10.5 %, 10.5 %)	0 ~ 78 mmHg, 0 mmHg (0 ~ 10.4 kPa, 0 kPa) (0 ~ 10.3 %, 0 %)	2 mmHg (0.3 kPa) (0.3 %)
Neonatal	2 ~ 80 mmHg, 80 mmHg (0.3 ~ 10.7 kPa, 10.7 kPa) (0.3 ~ 10.5 %, 10.5 %)	0 ~ 78 mmHg, 0 mmHg (0 ~ 10.4 kPa, 0 kPa) (0 ~ 10.3 %, 0 %)	2 mmHg (0.3 kPa) (0.3 %)
$InCO_2$ (mmHg, kPa, %)			
Adult	2 ~ 20 mmHg, 20 mmHg (0.3 ~ 2.7 kPa, 2.7 kPa) (0.3 ~ 2.6 %, 2.6 %)	0 ~ 18 mmHg, 0 mmHg (0 ~ 2.4 kPa, 0 kPa) (0 ~ 2.4 %, 0 %)	2 mmHg (0.3 kPa) (0.3 %)
Neonatal	2 ~ 20 mmHg, 20mmHg (0.3 ~ 2.7 kPa, 2.7 kPa) (0.3 ~ 2.6 %, 2.6 %)	0 ~ 18 mmHg, 0 mmHg (0 ~ 2.4 kPa, 0 kPa) (0.3 ~ 2.6 %, 0 %)	2 mmHg (0.3 kPa) (0.3 %)
IBP1 Systolic (mmHg, kPa)			
Adult	-50 ~ 260 mmHg, 200 mmHg (-6.7 ~ 34.7 kPa, 26.7 kPa)	-60 ~ 250 mmHg, 70 mmHg (-8.0 ~ 33.3 kPa, 9.3 kPa)	10 mmHg (1.3 kPa)
Neonatal	-50 ~ 260 mmHg, 130 mmHg (-6.7 ~ 34.7 kPa, 17.3 kPa)	-60 ~ 250 mmHg, 50 mmHg (-8.0 ~ 33.3 kPa, 6.7 kPa)	10 mmHg (1.3 kPa)
IBP1 Diastolic			
Adult	-50 ~ 260 mmHg, 160 mmHg (-6.7 ~ 34.7 kPa, 21.3 kPa)	-60 ~ 250 mmHg, 30 mmHg (-8.0 ~ 33.3 kPa, 4.0 kPa)	10 mmHg (1.3 kPa)
Neonatal	-50 ~ 260 mmHg, 100 mmHg (-6.7 ~ 34.7 kPa, 13.3 kPa)	-60 ~ 250 mmHg, 10 mmHg (-8.0 ~ 33.3 kPa, 1.3 kPa)	10 mmHg (1.3 kPa)
IBP1 Mean			
Adult	-50 ~ 260 mmHg, 180 mmHg (-6.7 ~ 34.7 kPa, 24.0 kPa)	-60 ~ 250 mmHg, 40 mmHg (-8.0 ~ 33.3 kPa, 5.3 kPa)	10 mmHg (1.3 kPa)
Neonatal	-50 ~ 260 mmHg, 110 mmHg	-60 ~ 250 mmHg, 20 mmHg	10 mmHg

Parameters	Upper Limit, Default	Lower Limit, Default	Resolution
	(-6.7 ~ 34.7 kPa, 14.7 kPa)	(-8.0 ~ 33.3 kPa, 2.7 kPa)	(1.3 kPa)
IBP2 Systolic			
Adult	-50 ~ 260 mmHg, 200 mmHg (-6.7 ~ 34.7 kPa, 26.7 kPa)	-60 ~ 250 mmHg, 70 mmHg (-8.0 ~ 33.3 kPa, 9.3 kPa)	10 mmHg (1.3 kPa)
Neonatal	-50 ~ 260 mmHg, 130 mmHg (-6.7 ~ 34.7 kPa, 17.3 kPa)	-60 ~ 250 mmHg, 50 mmHg (-8.0 ~ 33.3 kPa, 6.7 kPa)	10 mmHg (1.3 kPa)
IBP2 Diastolic			
Adult	-50 ~ 260 mmHg, 160 mmHg (-6.7 ~ 34.7 kPa, 21.3 kPa)	-60 ~ 250 mmHg, 30 mmHg (-8.0 ~ 33.3 kPa, 4.0 kPa)	10 mmHg (1.3 kPa)
Neonatal	-50 to 260 mmHg, 100 mmHg (-6.7 ~ 34.7 kPa, 13.3 kPa)	-60 to 250 mmHg, 10 mmHg (-8.0 ~ 33.3 kPa, 1.3 kPa)	10 mmHg (1.3 kPa)
IBP2 Mean			
Adult	-50 to 260 mmHg, 180 mmHg (-6.7 ~ 34.7 kPa, 24.0 kPa)	-60 to 250 mmHg, 40 mmHg (-8.0 ~ 33.3 kPa, 5.3 kPa)	10 mmHg (1.3 kPa)
Neonatal	-50 to 260 mmHg, 110 mmHg (-6.7 ~ 34.7 kPa, 14.7 kPa)	-60 to 250 mmHg, 20 mmHg (-8.0 ~ 33.3 kPa, 2.7 kPa)	10 mmHg (1.3 kPa)

Alarm Limits Display

When the alarm limits display is ***On***, the monitor displays the alarm limits value on numerical areas.

Auto Alarm

When the auto alarm is ***On***, the monitor automatically sets the alarm limits upon the current measurement values by specified percentage.

Auto Alarm Setting

You can select the percentages each parameter to set automatically the alarm limits.

1. Select ***Auto alarm setting*** in the alarm limits menu by rotating the jog dial.
2. Select the parameter to be changed. Change the value by rotating the jog dial.

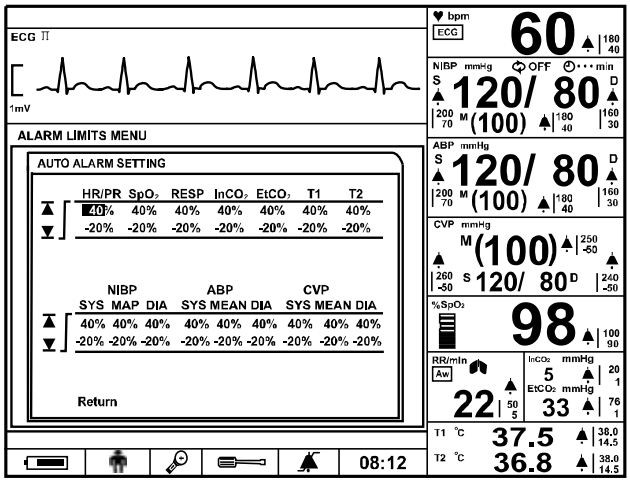


Figure 18. Auto Alarm setting menu

Audible Alarm Silence

WARNING: Do not silence the audible alarm or decrease its volume if patient safety could be compromised.

When an alarm occurs, you can silence the audible alarm for audible alarm silence period (30, 60, 90 or 120 seconds) selected via service menu. However, visual alarms continue during this time. The factory default of audible alarm silence period is 120 seconds.

To silence an audible alarm:

1. Press ***Alarm silence button*** to immediately silence the alarm tone. The alarm resumes after the audible alarm silence period if the alarm condition has not been corrected.
2. Check the patient and provide appropriate care.

During the audible alarm silence period, you can press ***Alarm silence button*** again to re-enable the audible alarm tones. Also, if another alarm occurs during the audible alarm silence period, the audible alarm tones will be automatically re-enabled.

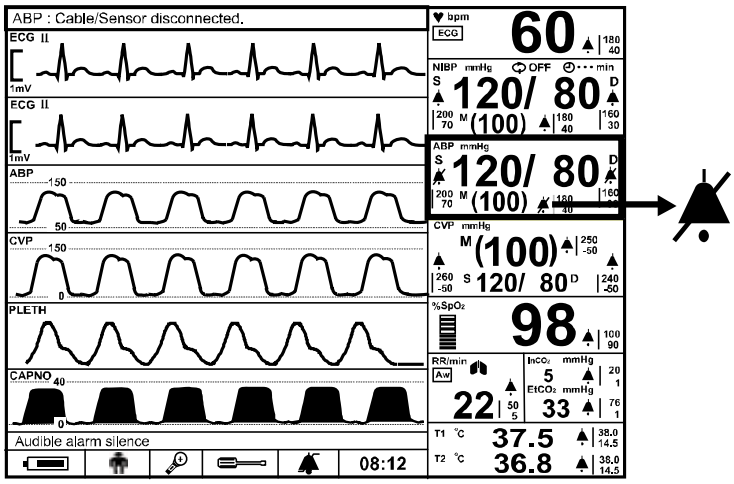


Figure 19.Audible Alarm Silence Display

Note: The audible alarms caused by some technical errors may be canceled by pressing ***Alarm silence button***. However, battery failure and physiological alarms cannot be canceled until the alarm condition is corrected.

Audible Alarm Suspend

WARNING: If an alarm condition occurs while in the Alarm Suspend state, the only alarm indication at the monitor will be visual displays related to the alarm condition.

To initiate an audible alarm suspend:

1. To initiate an audible alarm suspend, press ***Alarm silence button*** and hold it for at least 2 seconds.
2. To cancel the suspend condition, press ***Alarm silence button*** for 2 seconds again.

Note: You may disable physiological alarms of each vital sign via ***HR/PR, SpO_2, NIBP, Respiration, Temperature, IBP, CO_2 or Alarm/Limits menu***.

This action disables audible alarms for a user-defined ***Audible alarm suspend period*** (10, 20, 30 or 60 minutes) selected via service menu.

If Audible alarm suspend period is set to other than ***Off*** or ***Indefinite***, the audible alarm is not activated for the time interval and the message ***"Audible alarm suspended"*** is displayed. If ***Off*** is selected, the alarm suspension is not allowed to activate. If ***Indefinite*** is selected, the audible alarm suspension continues until canceled by pressing ***Alarm silence button*** again and the message ***"Audible alarm inhibited"*** is displayed. In this case, the monitor will remind the user every 3 minutes that the audible alarm is suspended or inhibited.

Note: The periods can only be changed by authorized personnel via ***Service menu***.

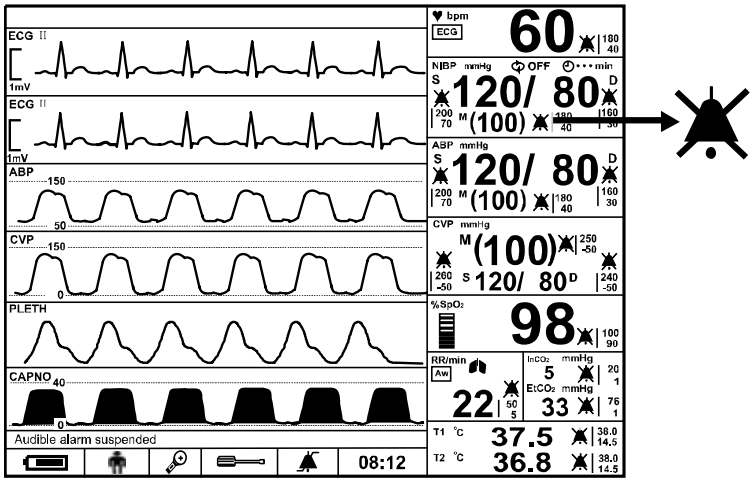


Figure 20. Audible Alarm Suspend Display

ECG MONITORING

⚠	**WARNING: For best product performance and measurement accuracy, use only accessories supplied or recommended by Colin Medical Technology. Use accessories according to the manufacturer's directions for use and your facility's standards.**
⚠	**WARNING: Line isolation monitor transients may resemble actual cardiac waveforms and thus inhibit heart rate alarms. Such transients may be minimized by proper electrode and cable placement, as specified in this manual and electrode directions for use.**
⚠	**WARNING: Do not use damaged ECG leads. Do not immerse ECG leads completely in water, solvents, or cleaning solutions. Do not sterilize ECG leads by irradiation, steam, or ethylene oxide. Follow the manufacturer's directions for use.**
⚠	**WARNING: Do not use ECG electrodes with expired dates. Do not use defective ECG electrodes. These might cause improper performance.**
⚠	**WARNING: ECG cables may be damaged if they are connected to a patient during defibrillation. Cables that have been connected to a patient during defibrillation should be checked for functionality before using again.**
⚠	**WARNING: It is possible for the patient to receive a burn due to an improperly connected electrosurgical unit. Additionally, the monitor could be damaged or measurement errors could occur. Place the ECG cable and leads as far as possible from the site of the electrosurgical unit and from the electrosurgical cables. This will minimize interference and the risk of burns to the patient.**
⚠	**WARNING: For pacemaker patients, the monitor may continue to count pacemaker rate during occurrences of cardiac arrest or some arrhythmias. To reduce the likelihood of this, ensure that the Pacer Detect setting is ON in the ECG waveform menu when monitoring such patients. Do not rely entirely upon the monitor alarms. Keep pacemaker patients under close surveillance.**
⚠	**WARNING: To ensure patient safety, the conductive parts of the ECG electrodes (including associated connectors) and other patient-applied parts should not contact other conductive parts, including earth ground, at any time.**

General

The process of depolarization and repolarization of the myocardium generates electric potentials that are sensed by ECG electrodes on the skin surface. These electrodes are typically attached to the patient's right arm, left arm, and left leg. The monitor processes and amplifies these signals and presents the ECG waveform on the screen. In addition to the acquisition of the QRS complex, the circuitry performs a number of other functions. The monitor can display:

- Heart rate in beats per minute
- Detection of a "lead off" condition if an electrode is disconnected or poorly connected
- Detection of the presence of pacemaker signals within the ECG waveform complex

Note: Occasionally, electromagnetic interference beyond the range guaranteed from manufacture's declaration may cause the monitor to display an "Check ECG Leads & Electrodes" alarm. This occurrence is rare, and duration should be short. When the interference ceases, the monitor removes the "Check ECG Leads & Electrodes" alarm. Refer to **Specification** section

Setup Connections

Note: Colin Medical Technology recommends the use of silver/silver chloride electrodes (Ag/AgCl). When dissimilar metals are used for different electrodes, the electrodes may be subject to large offset potentials due to polarization, which may be severe enough to prevent obtaining an ECG trace. Using dissimilar metals may also increase recovery time after defibrillation.

1. Select the electrodes to be used. Use only one type of electrode on the same patient to avoid variations in electrical resistance. Prepare the electrode sites according to electrode manufacturer's instructions. See Figure 21 and 22 for electrode placement configurations.

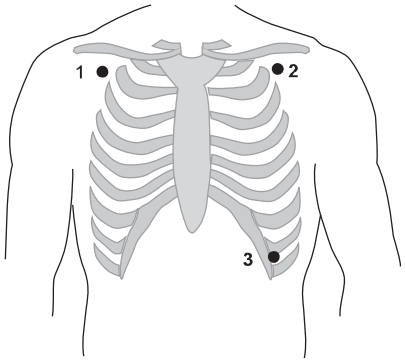


Figure 21. Standard 3 Electrode Placement

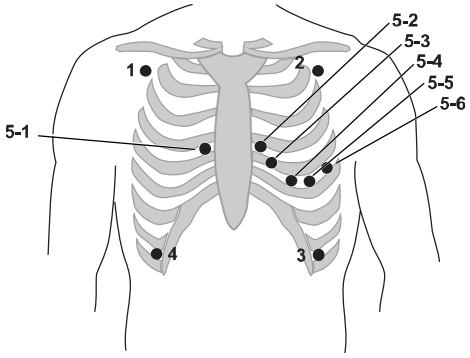


Figure 22. 5 Electrode Placement

Note: One of 5-1 to 5-6 Lead electrode placement sites for the fifth lead.

2. Connect the ECG lead wires and ECG cable.
3. Connect the ECG cable to the ECG connector on the monitor's left panel.

4. Attach the leads to the electrodes, and then apply the electrodes to the patient, using the color-code guide in Table 20. Verify that the desired Lead Selection is active in the ECG waveform area. Refer to Table 21. Lead II is best suited for most monitoring situations.

Table 20. ECG Lead Colors

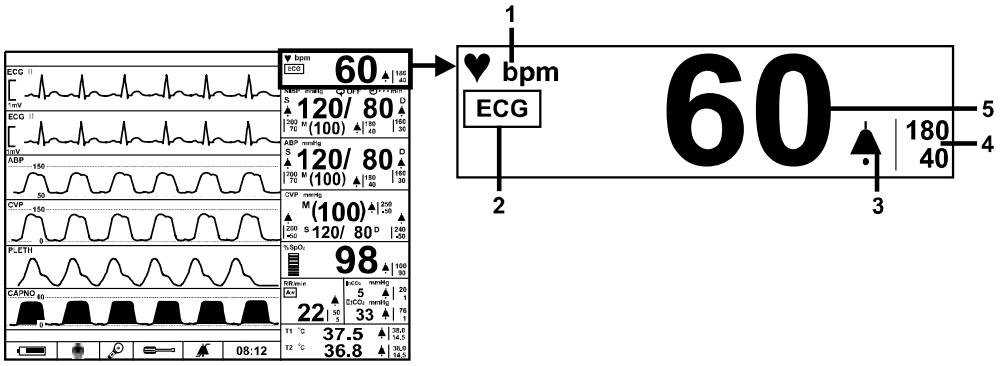
Lead	AAMI	IEC
1. Right arm	White (RA)	Red (R)
2. Left arm	Black (LA)	Yellow (L)
3. Left leg	Red (LL)	Green (F)
4. Right leg	Green (RL)	Black (N)
5-1 to 5-6. V (Chest)	Brown (V)	White (C)

Table 21. ECG Lead Pairs

Lead-Selection	Electrode Differential (AAMI)	Electrode Differential (IEC)
I	RA LA	R L
II	RA LL	R F
III	LA LL	L F
V (Chest)	(RA+LA+LL)/3 Chest (V)	(R+L+F)/3 Chest (C)
aVR	– (Lead I + Lead III/2)	– (Lead I + Lead III/2)
aVL	(Lead I – Lead III)/2	(Lead I – Lead III)/2
aVF	(Lead II + Lead III)/2	(Lead II + Lead III)/2

Description of HR/PR Menu Functions

The calculated Heart rate/Pulse rate may be derived from different sources (ECG, IBP, SpO_2 or NIBP) as shown by the icon in the HR/PR numerical area.



1 HR/PR icon
2 HR/PR source icon
3 HR/PR alarm icon
4 HR/PR alarm limits value
5 HR/PR value

Figure 23. HR/PR display

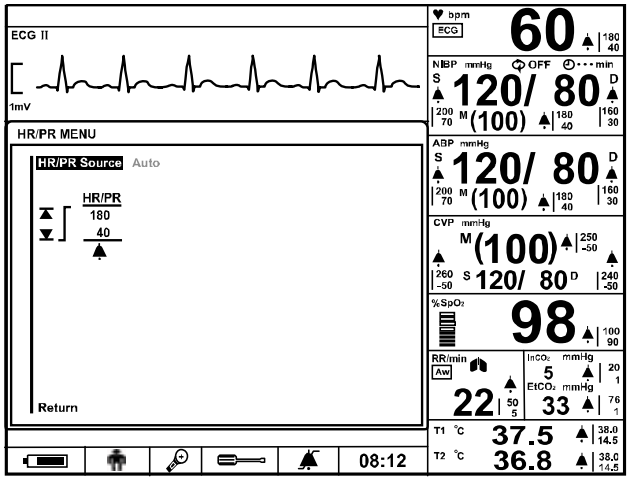


Figure 24. HR/PR Menu

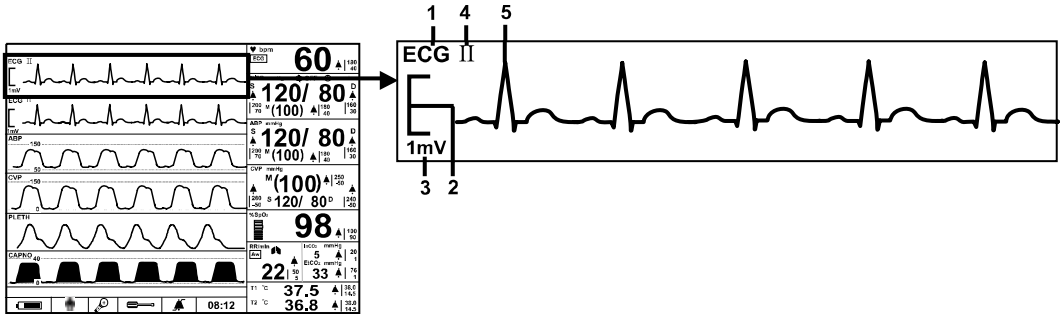
Table 22. HR/PR Menu

Level 1 Menu	Level 2 Menu or Response
HR/PR MENU	
HR/PR Source	Auto (ECG>IBP>SpO_2>NIBP)
	HR (ECG)
	PR (IBP>SpO_2>NIBP)
(Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
HR/PR Alarm Suspend	On, Off
Return	

HR/PR Source

You may select ***HR***, ***PR*** or ***Auto*** to decide the source of the heart rate or pulse rate. If you select ***Auto***, the monitor automatically derives the heart rate or pulse rate from one of the monitoring parameters in this order of priority: ECG, IBP, SpO_2 or NIBP. When ***HR*** is selected, the heart rate is measured from ECG. When ***PR*** is selected, the pulse rate is measured from in order of IBP, SpO_2 or NIBP. The color of the source icon will be changed according to current source. If the pulse rate is derived from NIBP, the value will be displayed for only 180 minutes after the NIBP measurement, then the value will be removed from the display. The HR/PR tone volume can be adjusted in the ***Setup menu***. Refer to the **Using the Monitor** section. (See Figure 11, Table 11)

Description of ECG Waveform Menu Functions



1 ECG waveform icon
2 ECG size bar
3 ECG size scale
4 ECG lead pair
5 ECG waveform

Figure 25. ECG Waveform display

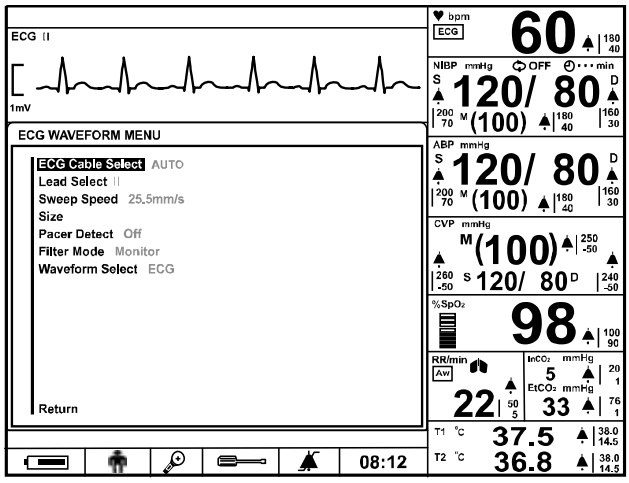


Figure 26. ECG Waveform Menu

Table 23. ECG Waveform Menu

Level 1 Menu	Level 2 Menu or Response
ECG WAVEFORM MENU	
ECG cable select	Auto, 5 Leads, 3 Leads
Lead Select	Lead I, II, III, aVR, aVL, aVF, V (Chest Lead)
Sweep Speed	12.5 mm/s, 25.0 mm/s, 50.0 mm/s
Size *(mm per 1mV)*	×1/4, ×1/2, ×1, ×1.5, ×2 Note: The size is selected by pressing on the up/down button of the screen.
Pacer Detect	On, Off
Filter Mode	Monitor, Low Extend, Filter, Respiration Rejection
Waveform Select	ECG, Pleth, Respiration, (P1 Label),(P2 Label), Capno
Return	

ECG Cable Select

When ECG cable select is set to ***Auto***, the monitor sets ECG leads automatically. Also, you can select the 3 Leads or 5 Leads manually.

Lead Select

When leads are attached, the ***Lead Select*** menu is displayed with the available ECG lead selection. You can select the desired ECG lead. For more information about the lead selection, refer to Table 21.

Sweep Speed

The user-selectable sweep speed determines the speed at which the ECG waveform trace moves across the screen. ***Sweep Speed*** can be selected from 12.5 mm/s, 25.0 mm/s and 50.0 mm/s, and ECG waveform is synchronized with Pleth waveform and IBP waveform.

Size

The user-selectable ECG waveform size allows you to adjust the amplitude of an ECG waveform. The size can be selected from ×1/4, ×1/2, ×1, ×1.5 or ×2. When the size is ×1 selected, 1mV ECG signal is shown as 1cm on the display and on the print-out.

Pacer Detect

Pacer detect should always be ***On*** for patients with pacemakers (refer to the warning in this section). When ***Pacer detect*** is ***On***, the monitor detects and filters pacemaker-generated signals so that they will not be calculated in determining a patient's heart rate. When monitoring the patient without pacemaker, Pacer detect should be set to ***Off*** to avoid misdiagnosis.

Filter Mode

The monitor can filter ECG waveform noise with different ranges of frequency response:
Low Extend (0.05 Hz to 40 Hz): Expands the range to display very low frequencies down to 0.05 Hz.
Filter (0.5 Hz to 30 Hz): Generally called a filter mode it reduces ECG waveform noise.
Monitor (0.5 Hz to 40 Hz): Choose this mode to see just the ECG waveform monitoring.
Respiration Rejection (1 Hz to 40 Hz): Removes the respiration signal measured by impedance method.

NIBP MONITORING

WARNING: For best product performance and measurement accuracy, use only accessories supplied or recommended by Colin Medical Technology. Use accessories according to the manufacturer's directions for use and your facility's standards.

WARNING: Inaccurate measurements may be caused by incorrect cuff application or use. This can include placing the cuff too loosely on the patient, using the incorrect cuff size, or not placing the cuff at the same level as the heart, leaky cuff or hose or excessive patient motion.

WARNING: In some cases, rapid, prolonged cycling of an oscillometric, noninvasive blood pressure monitor cuff has been associated with any or all of the following: ischemia, purpura, or neuropathy. Periodically observe the patient's limb to make sure that the circulation is not impaired for a prolonged period of time. Also make sure the cuff is placed according to directions in this manual and the cuff directions for use.

WARNING: Do not place the cuff, the catheter or SpO_2 sensor on an extremity being used for intravenous infusion or any area where circulation is compromised or has the potential to be compromised.

WARNING: As with all automatically inflatable blood pressure devices, continual cuff measurements can cause injury to the patient being monitored. Weigh the advantages of frequent measurement and/or use of CONT mode against the risk of injury.

WARNING: Ensure the patient is quiet with minimal movement during NIBP readings; minimize the patient's shivering.

WARNING: Never place the cuff on extremity being used for intravenous infusion or any area where circulation is compromised or has the potential to be compromised. Never fit NIBP system with Luer Lock adapters.

WARNING: Never use an adult monitor setting or cuff for an NIBP measurement on a neonatal patient. Adult inflation limits can be excessive for neonatal patients, even if a neonatal cuff is used.

CAUTION: In the automatic mode, the monitor displays results of the last blood pressure measurement until another measurement starts. If a patient's condition changes during the time interval between measurements, the monitor will not detect the change or indicate an alarm condition.

CAUTION: Any excessive patient motion may cause inaccurate measurements of non-invasive blood pressure. Minimize motion to improve blood pressure measurements.

CAUTION: Do not apply the blood pressure cuff to the same extremity as the one to which the SpO_2 sensor or IBP catheter is attached. Cuff inflation can disrupt SpO_2 monitoring and lead to nuisance alarms.

CAUTION: Make sure that heavy objects are not placed on the cuff hose. Avoid crimping or undue bending, twisting, or entanglement of the hose.

Note: Blood pressure measurements can be affected by the position of the patient, the patient's physiological condition and other factors.

General

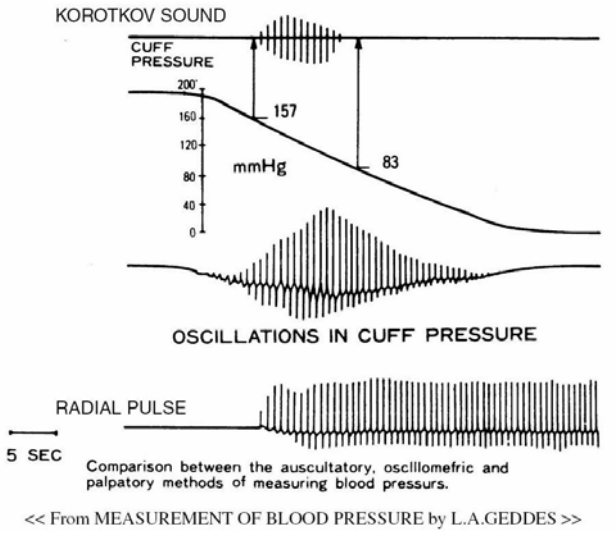
The monitor performs Non-Invasive Blood Pressure measurements using the oscillometric measuring technique. A notarized pump inflates the cuff to initially blocking the flow of blood in the extremity. Then, under monitor control, the pressure in the cuff is gradually reduced, while a pressure transducer detects air pressure and transmits a signal to the NIBP circuitry.

When the cuff pressure is still above systolic pressure, small pulses or oscillations in the cuff pressure begin to be sensed by the transducer. As the cuff continues to deflate, oscillation amplitude increases to a maximum and then decreases. When maximum oscillation amplitude occurs, the cuff pressure at that time is measured as mean arterial pressure (MAP). The systolic and diastolic pressures are calculated based on analysis of the oscillation amplitude profile.

Oscillometric Method

The blood pressure values are determined by measuring the small oscillations (changes) in the cuff pressure caused by the heart's contractions as the pressure in the cuff is released. Colin's measurement technology utilizes a unique deflation technique, Dynamic Linear Deflation. This cuff deflation technique allows a Colin monitor to measure each small change in the cuff pressure oscillations that directly correspond to the measurement's systolic, mean and diastolic blood pressure values.

The cuff is first increased in pressure until it reaches a pressure above arterial occlusion. As the cuff starts to deflate, the pulse rate of the patient is determined and the deflation speed of the cuff is modified to create a patient specific deflation speed. As the pressure decreases, small cuff pressure oscillations are recorded that correspond to the applied pressure of the blood under the cuff as the heart contracts. These oscillations increase in strength as the cuff pressure approaches the systolic blood pressure value. A sudden increase in oscillation amplitude indicates that the patient's systolic blood pressure is now able to push blood completely through beneath the cuff. The oscillation amplitude continues to increase as the pressure in the cuff is decreases until the mean blood pressure value is reached. The oscillation strength then starts to diminish and finally drop off as the diastolic blood pressure value is reached.



Comparison between the auscultatory, oscillomefric and palpatory methods of measuring blood pressurs.

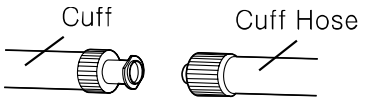
<< From MEASUREMENT OF BLOOD PRESSURE by L.A.GEDDES >>

The oscillometric method does not determine an instantaneous blood pressure reading like the auscultatory method employing a microphone-type auto blood pressure monitor but, as described above, determines blood pressure from an uninterrupted changing curve, which means that the oscillometric method is not easily effected by external noise and electrosurgical instruments.

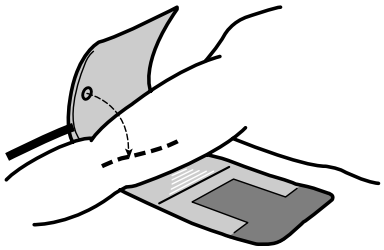
Note: This equipment is suitable for use in the presence of electro-surgery.

Setup Connections

1. Measure the patient's limb and select a proper size cuff. As a general rule, cuff width should span approximately two-thirds of the distance between the patient's elbow and shoulder.
2. Connect the cuff hose to the connector on the monitor's left panel and turn to right to lock. (see Figure 3).
3. Connect a cuff to the cuff hose and turn the connector to right to lock the hoses together. Firm connection must be made.



4. Wrap the cuff around a hare arm or around an arm covered in thin clothing. Thick clothing or a rolled up sleeve will cause a major discrepancy in the blood pressure reading.
5. Warp the cuff around the patient's arm so that the center of the cuff's rubber bladder sits on the artery of the upper arm. The hose should be brought out from the peripheral side without bending (The Brachial artery is located on the inside of the patient's upper arm.) At this time, check that the index line on the edge of the cuff sits inside the range. Use a different sized cuff if the index line is outside of the range because this will cause a major discrepancy in blood pressure reading.



6. The adult cuff should be wrapped around the arm tightly enough so that only two fingers can be inserted under it, above and below the cuff.
7. Maintain the height of the cuff-wrapped upper arm artery to that of the heart's right ventricle during measurement.
8. Follow the cuff directions for use when applying the cuff to the arm.

Table 24. Cuff Size

	Model Number	Cuff width (cm)	Arm circumference (cm)
Pediatric	Cuff No.1	7	12 to 18
	Cuff No.2	9	17 to 23
Adult	Cuff No.3	12	23 to 33
	Cuff No.4	14	31 to 40
Neonate	Cuff No.10	2.5	3.5 to 6
	Cuff No.11	3	5.0 to 7.5
	Cuff No.12	4	7.5 to 10.5
	Cuff No.13	5	8.5 to 13

NIBP Measurement Modes

Blood pressure measurements can be made in three modes:

- **MANUAL mode:** Single measurement of systolic/diastolic/mean arterial pressure.
- **Automatic (AUTO) mode:** Measurements at preset intervals.
- **Continuous (CONT) mode:** As many measurements as possible within a 5 minutes period.

To Initiate MANUAL Measurement Mode

1. Press the ***NIBP Start/Stop button***.

A single blood pressure measurement will be made. The measurement will be displayed for 180 minutes unless another measurement is initiated. A manual NIBP reading can be obtained in AUTO mode by pressing ***NIBP start/stop button*** between two AUTO measurements without the cancellation of AUTO mode.

To Initiate Automatic (AUTO) Measurement Mode

1. Press ***NIBP interval button*** to select the desired automatic mode interval from ***NIBP interval setting menu*** (see Table 25). The initial measurement will start automatically in a selected interval. The automatic mode can be also activated by pressing ***NIBP Start/Stop button*** after selecting the interval.

   - ✓ **NIBP Auto Mode intervals**
     : Off, Cont, 1, 2, 2.5, 3, 5, 10, 15, 20, 30, 45, 60, 90, 120, 180 minutes

2. An NIBP reading can be cancelled by pressing ***NIBP Start/Stop button*** during the AUTO measurements.

Note: When the time interval is set to 1 minute, the initial measurement will automatically start after 5 seconds, and then the measurement interval will automatically become 2.5 minutes after 12 minutes elapsed.

The NIBP numerical area will display the ***NIBP auto mode interval*** and ***NIBP elapsed time icon***. The interval is the time from when one measurement starts to when the next measurement starts. The measurement value will be displayed until another measurement starts. When the AUTO mode is cancelled, the last measurement will be displayed for 180 minutes.

In AUTO mode, the monitor attempts to meet the requirement of SVRP (Safe Venous Return Pressure) as long as starting a new reading does not violate the requirement of being 30 seconds below SVRP between readings. A new blood pressure reading will not start until the 30 second period has elapsed. When CONT and 1 minute is selected in ***NIBP interval setting menu***, this SVRP can be shorten over 2 seconds since CONT is the intensive measurement during the short term which is 5 minutes in the BP-S510.

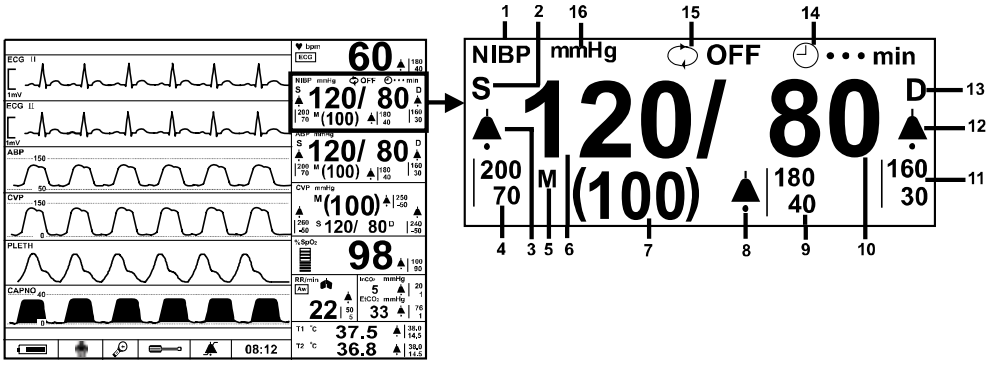
To Initiate Continuous (CONT) Measurement Mode

You may select ***Cont*** to activate the continuous measurement mode. The initial measurement will automatically starts in 5 seconds. The measurement interval will automatically become 2.5 minutes after 5 minutes elapsed. Also, if the ***NIBP start/stop button*** is pressed during CONT mode, the measurement will be canceled and the interval will be changed to 2.5 minutes.

To Stop Blood Pressure Measurements

You may press ***NIBP Start/Stop button*** at any time to stop the current measurement and deflate the cuff. If an automatic measurement is underway, next measurement will start at the next interval after the current measurement stops.

Description of NIBP Menu Functions



1	NIIBP icon	9	MAP alarm limits value
2	Systolic pressure icon	10	Diastolic pressure value
3	Systolic alarm icon	11	Diastolic pressure alarm limits value
4	Systolic alarm limits value	12	Diastolic pressure alarm icon
5	MAP icon	13	Diastolic pressure icon
6	Systolic pressure value	14	NIBP elapsed time
7	MAP value	15	NIBP auto mode interval
8	MAP alarm icon	16	NIBP unit

Figure 27. NIBP display

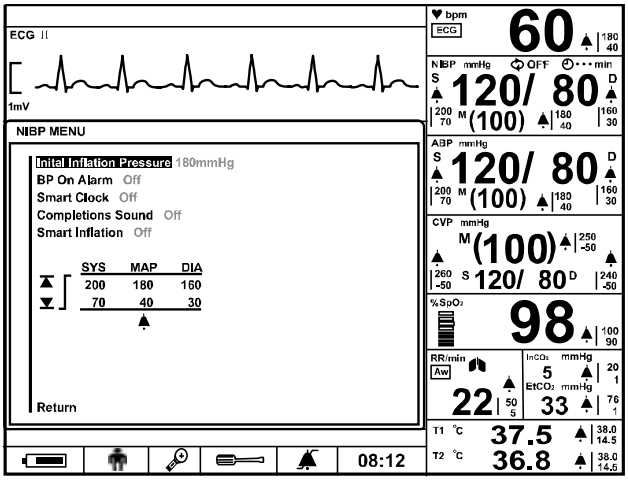


Figure 28. NIBP menu

Table 25. NIBP Menu

Level 1 Menu	Level 2 Menu or Response
NIBP MENU	
Initial Inflation Pressure	120, 140, 160, 180, 200, 220 (mmHg) (Adult) 80, 100, 120, 140 (mmHg) (Neonatal)
BP On alarm	On, Off
Smart Clock	On, Off
Completion Sound	On, Off
Smart Inflation	On, Off
(Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
NIBP Alarm Suspend	On, Off
Return	

Note: Initial Inflation Pressures shown above are for Adult patient mode. In order to set alarm limits to Neonatal mode, change Patient mode via ***Setup Menu***.

Note: The NIBP unit can only be changed by authorized personnel via ***Service menu***.

Initial Inflation Pressure

The inflating pressure can be set from 120 to 220 mmHg for adult or from 80 to 140 mmHg for neonatal.

BP on Alarm

If the BP on Alarm is ***On***, the monitor will automatically take a measurement when an alarm condition occur.

Smart Clock

If the smart clock is ***On***, the start of measurements will synchronize to the time. For example, after a measurement made at 10:03 with five-minute interval and then the smart clock set to On, next measurements will start at 10:05, 10:10 and another.

Completion Sound

When the completion sound is ***On***, the monitor sounds beep tones to notify the completion of the NIBP measurement.

Smart Inflation

When the smart inflation is ***On***, the suitable inflation value to the patient is automatically calculated during the inflation. The inflation value is automatically calculated around the expected systolic BP value + 45 mmHg.

SpO_2 MONITORING

WARNING: For best product performance and measurement accuracy, use only accessories manufactured by Tyco Healthcare Inc. Use accessories according to the manufacturer's directions for use and your facility's standards.

WARNING: Tissue damage can be caused by incorrect application or use of an SpO_2 sensor. Harm can be caused, for example, by wrapping the sensor too tightly, by applying supplemental tape, or by leaving a sensor on too long in one place. Inspect the sensor site as directed in the sensor directions for use to ensure skin integrity, correct positioning, and adhesion of the sensor.

WARNING: Do not use damaged SpO_2 sensors. Do not use an SpO_2 sensor with exposed optical components. Do not immerse sensor completely in water, solvents, or cleaning solutions because the sensor and connectors are not waterproof. Do not sterilize SpO_2 sensors by irradiation, steam or ethylene oxide. Refer to the cleaning instructions in the directions for use for reusable SpO_2 sensors.

WARNING: Inaccurate measurements may be caused by:

- **incorrect sensor application or use**
- **significant levels of dysfunctional hemoglobin (such as carboxyhemoglobin or methemoglobin)**
- **intravascular dyes such as indocyanine green or methylene blue**
- **exposure to excessive illumination, such as surgical lamps (especially ones with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, or direct sunlight**
- **excessive patient movement**
- **high-frequency electrosurgical interference and defibrillators**
- **venous pulsations**
- **placement of a sensor on an extremity with a blood pressure cuff, arterial catheter, or intravascular line**
- **patient conditions such as hypotension, severe vasoconstriction, severe anemia, hypothermia, cardiac arrest, or shock**
- **arterial occlusion proximal to the sensor**
- **environmental conditions**
- **unspecified length of the extension cable**

WARNING: Do not attach any cable to the sensor port connector that is intended for computer use.

CAUTION: The sensor disconnect error message and associated alarm indicate the sensor is either disconnected or the wiring is faulty. Check the sensor connection and, if necessary, replace the sensor, extension cable or both.

CAUTION: Reusable sensors may be used on the same site for a maximum of 4 hours, provided the site is inspected routinely to ensure skin integrity and correct positioning.

General

The monitor uses pulse oximetry to measure functional oxygen saturation in the blood. Because a measurement of SpO_2 is dependent upon light from the SpO_2 sensor, excessive ambient light can interfere with this measurement. SpO_2 and Pulse rate is updated every second. This monitor measures functional saturation - oxygenated hemoglobin expressed as a percentage of the hemoglobin that can transport oxygen. It does not detect significant amounts of dysfunctional hemoglobin, such as carboxyhemoglobin or mehtemoglobin.

Functional versus Fractional Saturation

This monitor measures functional saturation — oxygenated hemoglobin expressed as a percentage of the hemoglobin that can transport oxygen. It does not detect significant amounts of dysfunctional hemoglobin, such as carboxyhemoglobin or methemoglobin. In contrast, hemoximeters such as the IL482 report fractional saturation — oxygenated hemoglobin expressed as a percentage of all measured hemoglobin, including measured dysfunctional hemoglobin. To compare functional saturation measurements to those from an instrument that measures fractional saturation, fractional measurements must be converted as follows:

$$\textbf{functional saturation} = \frac{\textbf{fractional saturation}}{\textbf{100 – (\%carboxyhemoglobin + \%methemoglobin)}} \times \textbf{100}$$

Measured versus Calculated Saturation

When saturation is calculated from a blood gas partial pressure of oxygen (PO2), the calculated value may differ from the SpO_2 measurement of the monitor. This usually occurs because the calculated saturation was not appropriately corrected for the effects of variables that shift the relationship between PO2 and pH, temperature, the partial pressure of carbon dioxide (PCO_2), 2, 3-DPG, and fetal hemoglobin.

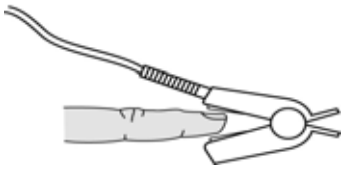
Automatic Calibration

Because light absorption by hemoglobin is wavelength dependent and because the mean wavelength of LEDs varies, an oximeter must know the mean wavelength of the *OXIMAX* sensor's red LED to accurately measure SpO_2. The wavelength range of the light emitted are near 660 nm and 890 nm with the energy not exceeding 15 mW. During monitoring, the instrument's software selects coefficients that are appropriate for the wavelength of that individual sensor's red LED; these coefficients are then used to determine SpO_2.
Additionally, to compensate for differences in tissue thickness, the light intensity of the sensor's LEDs is adjusted automatically.

Setup Connections

When selecting a sensor, consider the patient's weight and activity, adequacy of perfusion, availability of sensor sites, need for sterility, and anticipated duration of monitoring. Refer to Table 26, or contact Tyco Healthcare Inc. sales department for ordering information.

1. Select the proper sensor for the patient.
2. Connect the extension cable to the SpO_2 connector on the monitor's left panel and lock it. (see Figure 3)
3. Connect the sensor to the extension cable and lock it.
4. Carefully apply the sensor to the patient, as described in the sensor directions for use. Observe all warnings and cautions in the directions for use.



Note: Refer to directions for use to make sure the proper placement for various types of SpO_2 sensor.

Note: Periodically check to see that the sensor remains properly positioned on the patient and that skin integrity is acceptable. Refer to the sensor directions for use.

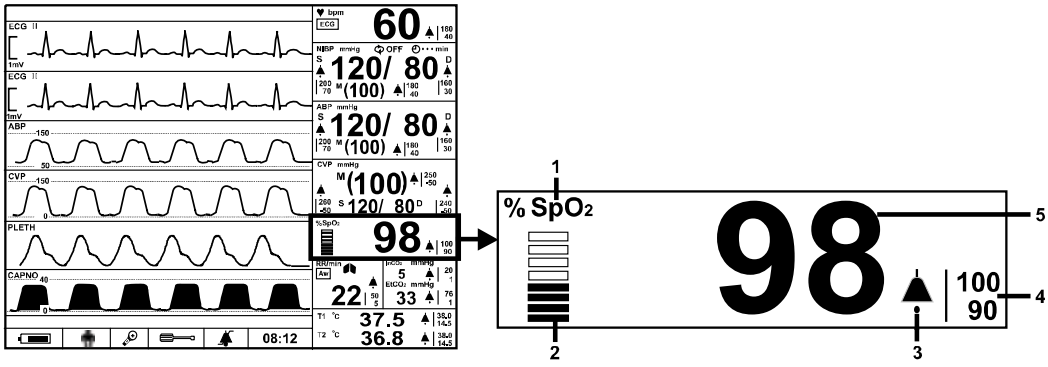
Table 26. SpO_2 Sensors

Sensor	Model	Patient Size
OXIMAX oxygen transducer (Sterile, single-use only)	MAX-N MAX-I MAX-P MAX-A MAX-AL MAX-R	<3 or >40 kg 3 to 20 kg 10 to 50 kg >30 kg >30 kg >50 kg
OXIMAX Oxiband ® oxygen transducer (Reusable with disposable non-sterile adhesive)	OXI-A/N OXI-P/I	<3 or >40 kg 3 to 40 kg
OXIMAX Durasensor ® Oxygen transducer (Reusable, non-sterile)	DS-100A	>40 kg
OXIMAX OxiCliq ® oxygen transducers (Sterile, single-use only)	P N I A	10 to 50 kg <3 or >40 kg 3 to 20 kg >30 kg
OXIMAX Dura-Y ® multisite oxygen transducer (Reusable, non-sterile) For use with the Dura-Y sensor: Ear clip (Reusable, non-sterile) *Pedi-Check* TM pediatric spot-check clip (Reusable, non-sterile)	D-YS D-YSE D-YSPD	>1 kg >30 kg 3 to 40 kg
OXIMAX MAX-FAST adhesive reflectance oxygen transducer	MAX-FAST	>40 kg

Pulse Amplitude Indicator

The pulse amplitude indicator is the segmented display within the SpO_2 numerical area that shows the relative strength of the detected pulse. A stronger pulse causes a larger amplitude indicator.

Description of SpO2 Menu Functions



1 SpO_2 icon
2 Pulse amplitude indicator
3 SpO_2 alarm icon
4 SpO_2 alarm limits value
5 SpO_2 value

Figure 29. SpO_2 Display

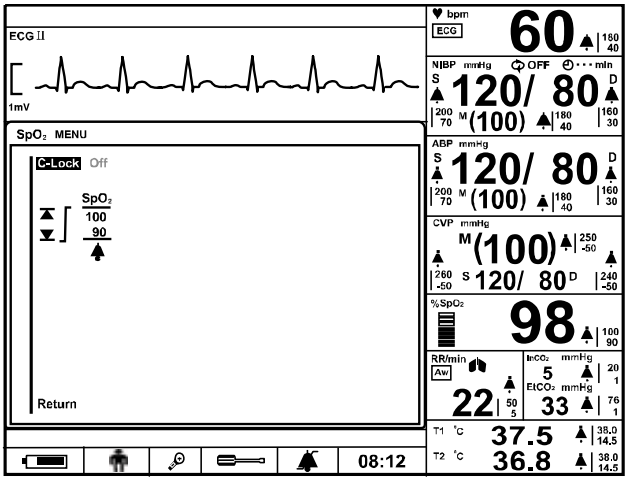


Figure 30. SpO_2 Menu

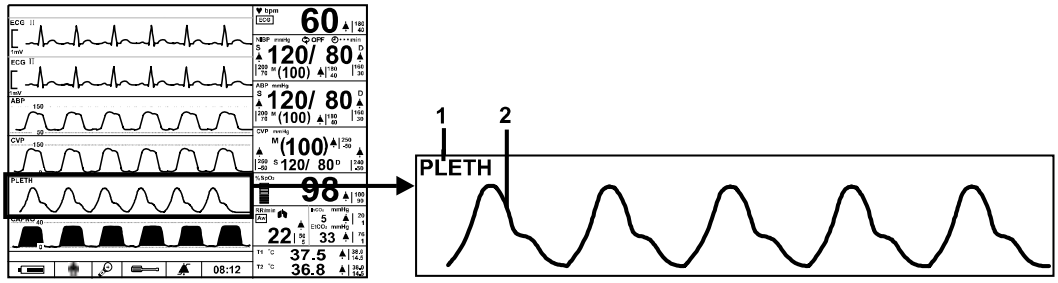
Table 27. SpO_2 Menu

Level 1 Menu	Level 2 Menu or Response
SpO_2 MENU	
C-Lock	On, Off
(Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
SpO_2 Alarm Suspend	On, Off
Return	

C-Lock

When C-Lock is turned on in the SpO_2 menu, C-Lock automatically becomes operational any time a valid ECG signal is detected by the monitor. It is not necessary to turn C-Lock off if an ECG signal is not available; the monitor handles this function automatically. If the ECG signal is noisy, or of poor quality, SpO_2 performance may be improved by turning C-Lock off. C-Lock provides ECG synchronization for more reliable saturation measurements. An ECG (R-wave) signal can be used as a time reference to identify the pulse and synchronize saturation measurements. C-Lock enhances performance while maintaining rapid response time.

Description of Pleth Waveform Menu Functions



1 Pleth waveform icon 2 Pleth waveform

Figure 31. Pleth Waveform Display

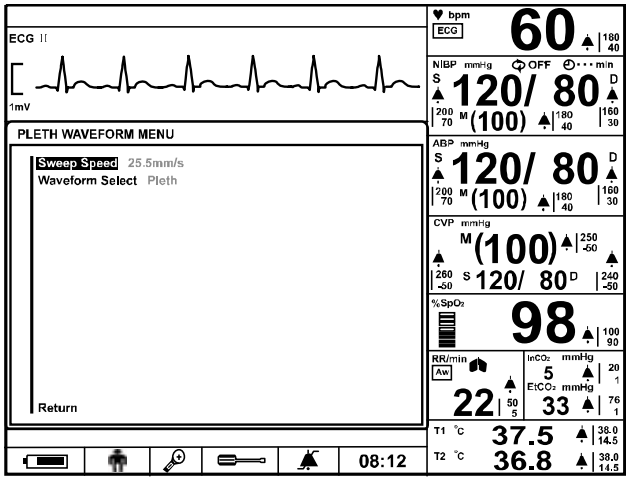


Figure 32. Pleth Waveform Menu

Table 28. Pleth Waveform Menu

Level 1 Menu	Level 2 Menu or Response
PLETH WAVEFORM MENU	
Sweep Speed	12.5 mm/s, 25.0 mm/s, 50.0 mm/s
Waveform Select	ECG, Pleth, Respiration, (P1 Label), (P2 Label), Capno
Return	

Sweep Speed

The user-selectable Sweep Speed determines the speed at which pleth waveform trace moves across the screen. ***Sweep Speed*** can be selected from 12.5 mm/s, 25.0 mm/s and 50.0 mm/s, and Pleth waveform is synchronized with ECG waveform and IBP waveform.

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RESPIRATION MONITORING

⚠	**WARNING: For best product performance and measurement accuracy, use only accessories supplied or recommended by Colin Medical Technology. Use accessories according to the manufacturer's directions for use and your facility's standards.**
⚠	**WARNINGS: The monitor does not detect apnea when the respiration signal is measured by trans-thoracic impedance.**
⚠	**WARNING: Keep patients under close surveillance when monitoring respiration. Respiration signals are relatively more sensitive to interference from radiated electromagnetic signals. Thus, it is possible, although unlikely, that radiated electromagnetic signals from sources external to the patient and monitor can cause inaccurate respiration readings. Do not rely entirely on the monitor respiration readings for patient assessment. If measured waveforms are not appropriate readings, check external condition to ensure there is no equipment to affect electromagnetic interference.**

General

The impedance respiration measurement uses the impedance between ECG electrodes. Human respiration takes place by chest expansion by the respiratory muscle. As the chest expands in the inspiratory movement, the impedance between the ECG electrodes will change. The monitor detects respiration rate by putting high-frequency current between RA and LA of the ECG electrodes.

The airway respiration measurement uses gases coming into the airway adapter in case of an $EtCO_2$ option equipped. The monitor detects respiration rate by computing each breath cycle from continuous capno waveform.

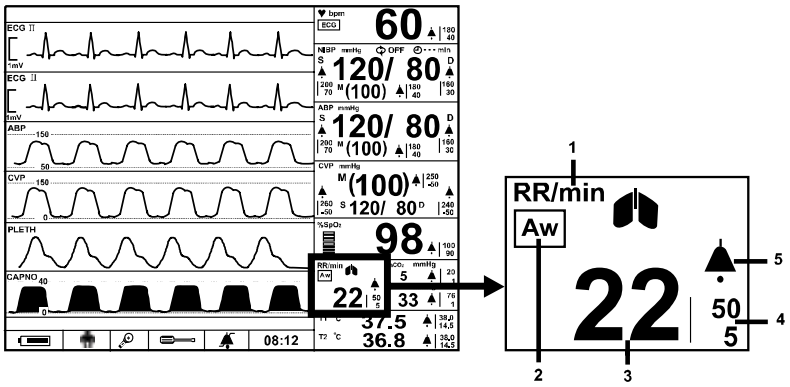
Setup Connections

Refer to the **ECG Monitoring** section to acquire the respiration signal by the patient impedance using the ECG electrodes, leads and cable.

The performance of the impedance respiration can be improved by the particular placement of the Left arm (LA) and Right arm (RA) electrodes. (See ***Standard ECG electrode placement*** in Figure 21)

Refer to the **Capnography Monitoring** section to detect the respiration signal by the airway adapter in case that an EtCO2 option equipped.

Description of Respiration Menu Functions



1 Respiration icon
2 Respiration source icon
3 Respiration value
4 Respiration alarm limits value
5 Respiration alarm icon

Figure 33. Respiration Display

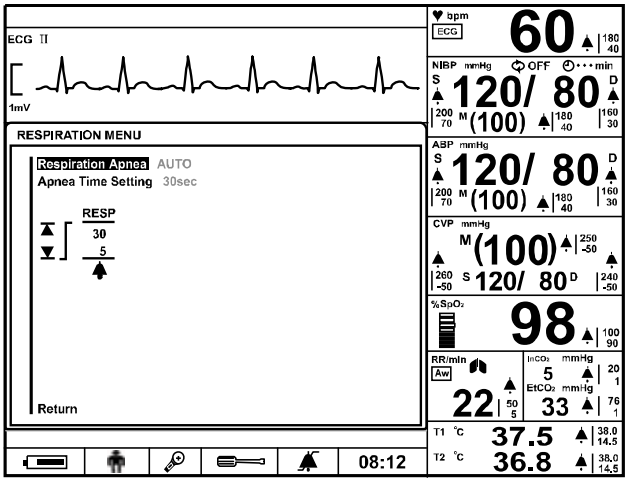


Figure 34. Respiration Menu

Table 29. Respiration Menu

Level 1 Menu	Level 2 Menu or Response
RESPIRATION MENU	
Respiration/Apnea	Off, Auto (awRR>imRR), awRR, imRR
Apnea Time Setting	Off, 20, 30, 40, 60, Step 60, Step 90
(Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
Respiration Alarm Suspend	On, Off
Return	

Respiration / Apnea Source

You can select either awRR or imRR for the source of the respiration rate. If you select Auto, the monitor will automatically derive the respiration rate from one of the monitoring parameters in this order of priority; awRR and imRR.

Note: You can select awRR as the source when CO_2 module is installed.

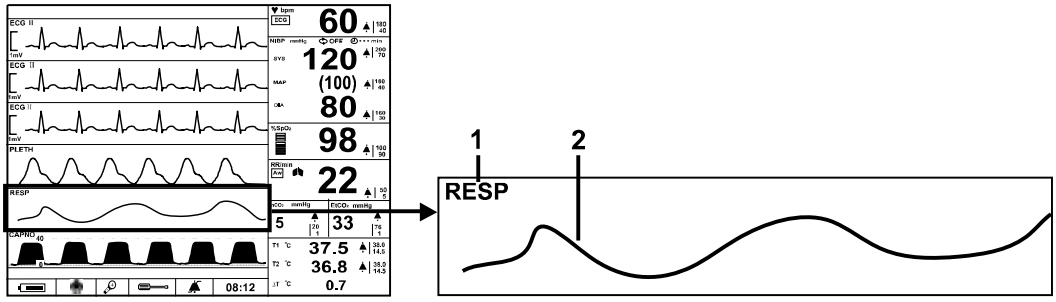
Apnea Time Setting

When the patient's breath is not detected from the airway measurement for a selected time setting, the monitor will activate an apnea alarm. When ***Step 60*** is selected, the monitor will sound two beeps in 20 second interval from no breath. At 60 seconds elapsed, an apnea alarm will be activated. When ***Step 90*** is selected, the monitor will sound three beeps in 30 second interval from no breath. At 90 seconds elapsed, an apnea alarm will be activated. If ***Off*** is selected, the monitor does not detect an apnea alarm.

When the monitor does not detect a respiration signal from the impedance measurement for 40 seconds, the monitor will activate a loss of respiration alarm.

Check the condition of the patient, then check the connections of the patient cables.

Description of Respiration Waveform Menu Functions



1 Impedance respiration waveform icon

2 Respiration waveform

Figure 35. Respiration Waveform Display

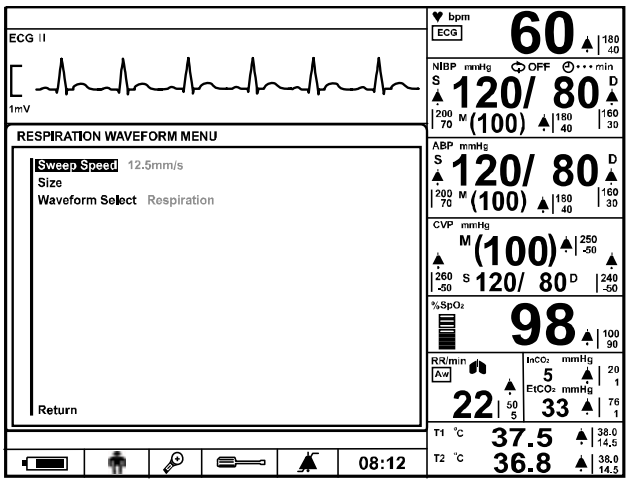


Figure 36. Respiration Waveform Menu

Table 30. Respiration Waveform Menu

Level 1 Menu	Level 2 Menu or Response
RESPIRATION WAVEFORM MENU	
Sweep Speed	6.25 mm/s, 12.5 mm/s, 25.0 mm/s
Size	×1/4, ×1/2, ×1, ×1.5, ×2 (5 steps)
Waveform Select	ECG, Pleth, Respiration, (P1 Label), (P2 Label) Capno
Return	

Sweep Speed

The user-selectable sweep speed determines the speed at which the respiration waveform trace moves across the screen. ***Sweep Speed*** can be selected from 6.25 mm/s, 12.5 mm/s and 25.0 mm/s, and the respiration waveform is synchronized with Capno waveform.

Size

Size allows you to adjust the waveform size. (5 steps: ×1/4, ×1/2, ×1, ×1.5, ×2)

TEMPERATURE MONITORING

WARNING: For best product performance and measurement accuracy, use only YSI 400 series temperature probes recommended by Colin Medical Technology. Use accessories according to the manufacturer's directions for use and your facility's standards.

General

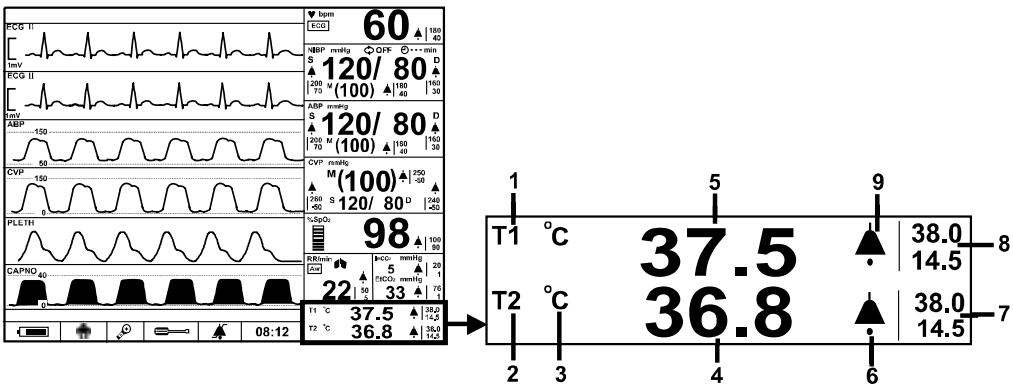
Measurement of patient temperature is accomplished by processing the signal from a probe containing a resistance element whose impedance is temperature dependent. These devices are called thermistors. The measuring time required to obtain accurate readings at the specific body site is about 10 seconds.

Setup Connections

The monitor is designed to accept signals from the temperature probes, YSI 400 series for skin, rectal or etc. Refer to the temperature probe directions for use for details

1. Insert a body temperature probe into the temperature connector on the monitor's left panel (see Figure 3).
2. Follow the directions for use accompanying the temperature probe.

Description of Temperature Menu Functions



1	Temperature 1 icon	6	Temperature 2 alarm icon
2	Temperature 2 icon	7	Temperature 2 alarm limits value
3	Temperature unit	8	Temperature 1 alarm limits value
4	Temperature 2 value	9	Temperature 1 alarm icon
5	Temperature 1 value		

Figure 37. Temperature Display

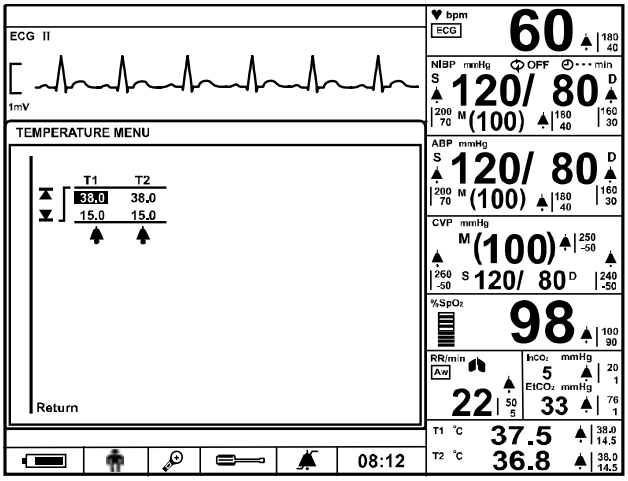


Figure 38. Temperature Menu

Table 31. Temperature Menu

Level 1 Menu	Level 2 Menu or Response
TEMPERATURE MENU	
(T1-Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
T1 Alarm Suspend	On, Off
(T2-Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
T2 Alarm Suspend	On, Off
Return	

Note: The temperature unit can only be changed by authorized personnel via ***Service menu***.

IBP MONITORING

⚠	**WARNING: Proper measurements may not be possible,** ● **if improper zero calibration was performed.** ● **if air bubbles are mixed into the patient circuit.** ● **if the height of the three-way tap for zero calibration and the right auricle have changed.**
⚠	**WARNING: If the pressure transducer has been dropped or subjected to strong physical shock, check for faults before use.**
⚠	**WARNING: Be sure to thoroughly read the instruction manuals for each item-such as the transducer, monitoring kit and transfusion set-that are used in invasive blood pressure measurements before using them. The cautions and warnings for such items are not included in this manual.**
⚠	**WARNING: Use a CE certified transducer with a sensitivity of 5μV/V/mmHg at an excitation voltage of 5VDC, and a measurement range of -50 to 300mmHg.**
⚠	**WARNING: Do not reuse disposable (single use) transducers.**
⚠	**WARNING: Ensure that reusable transducers are sufficiently sterilized.**
⚠	**WARNING: To ensure patient safety, do not contact any conductive parts to the applied part.**
⚠	**WARNING: Never install or remove the IBP module while the monitor is powered on. It is likely to break when installing or removing it while powered on.**

General

The invasive blood pressure measurement measures the systolic pressure, mean pressure, diastolic pressure and pulse rate for up to 2 blood pressure line channels using blood pressure transducers, and displays the blood pressure waveform.

Installing an IBP module

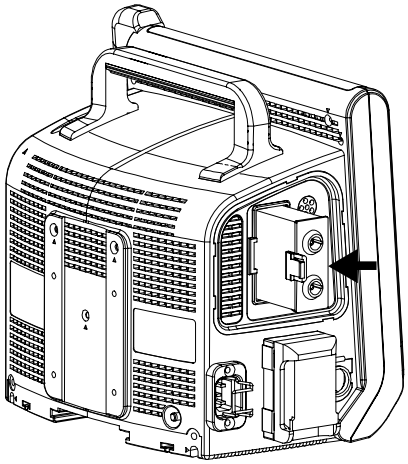


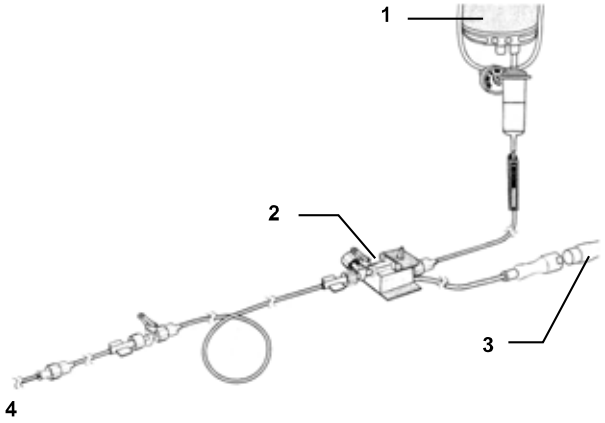
Figure 39. IBP Module Installation

1. Turn off the monitor.
2. Push the IBP module into the main unit until click.

Setup Connections

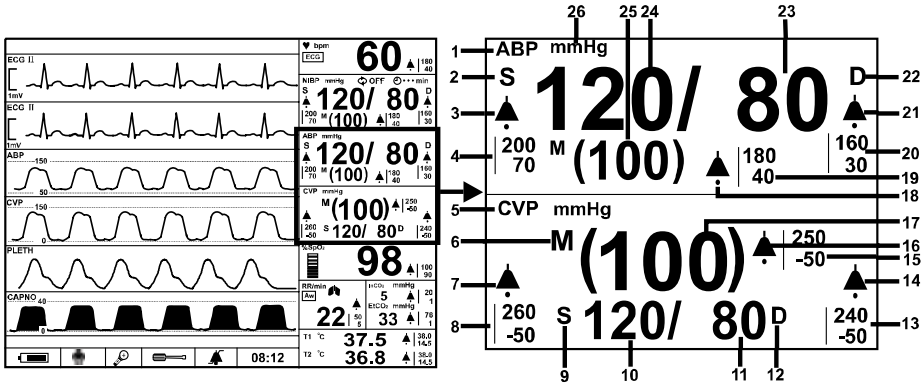
1. Connect the interface cable for the transducer to the IBP connector on the monitor's left panel. An interface cable for the transducer has to be selected correctly as it depends on the each transducer type. (see Figure 3)
2. Set up the patient circuit according to the directions for use of the transducer, monitoring kit and IV set.

The drawing below shows the example.



1	Pressure bag	3	Interface cable
2	Transducer	4	To patient

Description of IBP Menu Functions



1	IBP 1 icon	15	IBP 2 mean alarm limits value
2	IBP 1 systolic pressure icon	16	IBP 2 mean alarm icon
3	IBP 1 systolic alarm icon	17	IBP 2 mean pressure value
4	IBP 1 systolic alarm limits value	18	IBP 1 mean alarm icon
5	IBP 2 icon	19	IBP 1 mean alarm limits value
6	IBP 2 mean pressure icon	20	IBP 1 diastolic alarm limits value
7	IBP 2 systolic alarm icon	21	IBP 1 diastolic alarm icon
8	IBP 2 systolic alarm limits value	22	IBP 1 diastolic pressure icon
9	IBP 2 systolic pressure icon	23	IBP 1 diastolic pressure value
10	IBP 2 systolic pressure value	24	IBP 1 systolic pressure value
11	IBP 2 diastolic pressure value	25	IBP 1 mean pressure value
12	IBP 2 diastolic pressure icon	26	IBP 1 mean pressure icon
13	IBP 2 diastolic alarm limits value	27	IBP unit
14	IBP 2 diastolic alarm icon		

Figure 40. IBP Display

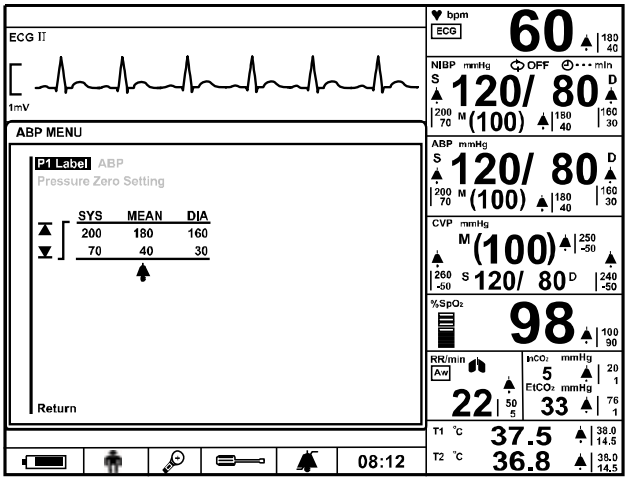


Figure 41. IBP Menu

Table 32. IBP 1 Menu

Level 1 Menu	Level 2 Menu or Response
(P1 Label) or (P2 Label) MENU	
P1 Label	P1, ABP
Pressure Zero Setting	No, Yes
(SYS Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
(MEAN Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
(DIA Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
(P1 Label) Alarm Suspend	On, Off
Return	

Table 33. IBP 2 Menu

Level 1 Menu	Level 2 Menu or Response
(P2 Label) MENU	
P2 Label	P2, CVP, PAP, LAP
Pressure Zero Setting	No, Yes
(SYS Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
(MEAN Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
(DIA Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
P2 Alarm Suspend	On, Off
Return	

Note: The IBP unit can only be changed by authorized personnel via ***Service menu***.

Label

Name of each channel (P1 or P2) can be selected in this menu.

Pressure Zero Setting

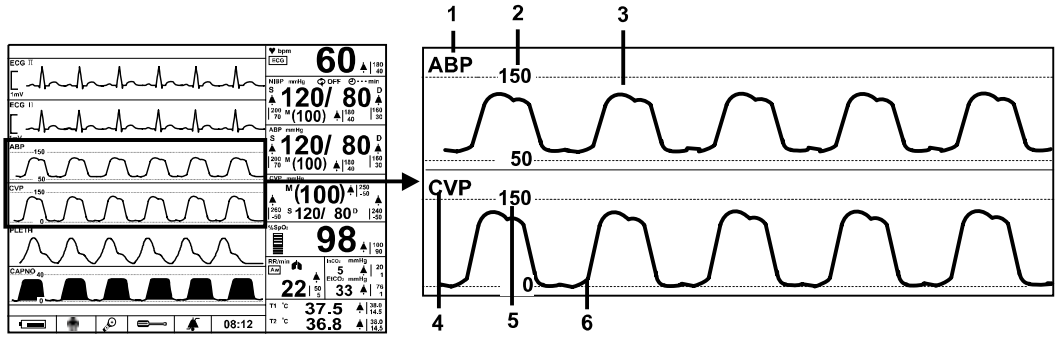
1. Three way tap for zero calibration should be set at the same level as patient's heart.
   - ✓ Make sure if there is no bubble in the each part.
   - ✓ Make sure if the drop volume of the IV set is at the proper position.
2. The handle of the three way tap should be to the patient so that the pressure to the transducer is open to the atmosphere level.
   - ✓ Please make sure if release part to the atmosphere in not covered by cap.
3. Set the pressure zero setting to ***Yes***. "Zero CAL in progress" message will appear.
4. When the message "Zero CAL in progress" is disappeared and measurement will be initiated.
5. When Zero Calibration is done, the handle of three way tap should be turned to the atmosphere direction and the release part should be covered by the cap.
6. IBP measurement can start by changing the lever of three way tap so as to transfer the pressure from the catheter to transducer.

Note: If there is bubble in the any part, you can remove the bubble by controlling the transducer.

Note: If zero calibration can not be done correctly, the readings will not be accurate.

Note: When zero calibration is done, make sure that release port of three way tap for Zero calibration is open, not covered by the cap of injector.

Description of IBP Waveform Menu Functions



1	IBP 1 waveform icon	4	IBP 2 waveform icon
2	IBP 1 scale bar	5	IBP 2 scale bar
3	IBP 1 waveform	6	IBP 2 waveform

Figure 42. IBP Waveform Display

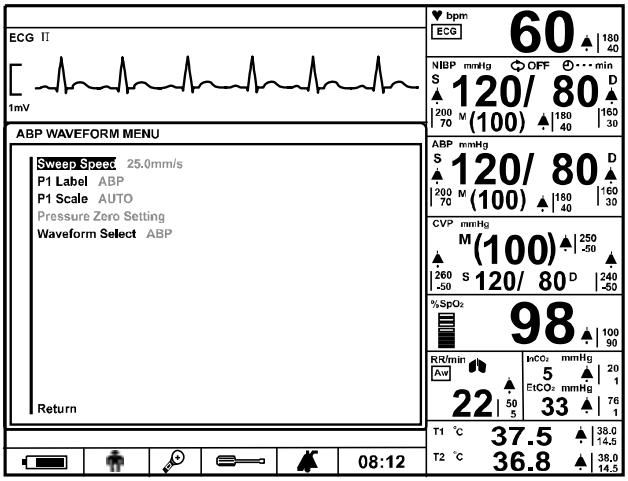


Figure 43. IBP Waveform Menu

Table 34. (P1 Label) Waveform Menu

Level 1 Menu	Level 2 Menu or Response
(P1 Label) WAVEFORM MENU	
Sweep Speed	12.5 mm/s, 25.0 mm/s, 50.0 mm/s
P1 Label	P1, ABP
P1 Scale	0~50, 0~100, 0~200, 0~300 mmHg, Auto
Pressure Zero Setting	No, Yes
Waveform Select	ECG, Pleth, Respiration, (P1 Label), (P2 Label), Capno
Return	

Table 35. (P2 Label) Waveform Menu

Level 1 Menu	Level 2 Menu or Response
(P2 Label) WAVEFORM MENU	
Sweep Speed	12.5 mm/s, 25.0 mm/s, 50.0 mm/s
P2 Label	P2, CVP, PAP, LAP
P2 Scale	0~20, 0~50, 0~100, 0~200, 0~300 mmHg, Auto
Pressure Zero Setting	No, Yes
Waveform Select	ECG, Pleth, Respiration, (P1 Label), (P2 Label), Capno
Return	

Sweep Speed

The user-selectable sweep speed determines the speed at which IBP waveform trace moves across the screen. ***Sweep Speed*** can be selected from 12.5 mm/s, 25.0 mm/s and 50 mm/s, and the IBP waveform is synchronized with ECG waveform and Pleth waveform.

Scale

The use can select the scale of P1 and P2 in the IBP waveform menu. When Auto is selected, the monitor automatically set the scale upon the IBP measurement value.

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CAPNOGRAPHY MONITORING

⚠	**Make sure that there is no leakage in the tubes connected to the patient. If there is leakage, external air will be sucked in and the sampling gas will be diluted, causing measurement values to drop.**
⚠	**Make sure that selection of a volatile anesthetic is done carefully. If an improper selection is made, the measurement values will be erroneous.**
⚠	**Do not use consumables other than those which are specified. Different sampling tube lengths or inside diameters may have an effect on the measurement values.**
⚠	**If the patient's breathing becomes fast, the dead space inside the sampling circuit or device, etc. is causing the response to drop, so correct measurements cannot be taken.** **Use it together with close observation of the capnogram.** **If the sampling flow rate is 65 ml/min, the response will drop still lower, so particular caution is necessary.**
⚠	**For the same reason as stated above, in the case of newborn infants and other patients who have a low air exchange rate per minute, correct measurements cannot be taken.**
⚠	**Do not use device without rectifying a gas calibration failure, as correct measurement readings will not be obtained.**
⚠	**The monitor is not use for in breathing system and inhalation anaesthetic agents**

General

The monitor provides the continuous end-tidal carbon dioxide ($EtCO_2$), inspired carbon dioxide ($InCO_2$), and respiration rate by using a side stream type gas module which uses a suction pump to sample the gases in the patient's inhaled and exhaled breath. CO_2 has the characteristic of absorbing infrared light, so the concentration of the gas is measured by the amount of infrared absorption. The sampled gases are analyzed using an internal sensor. The inhalation and exhalation gas concentrations are measured respectively. The respiration rate is measured from the changes of this curve.

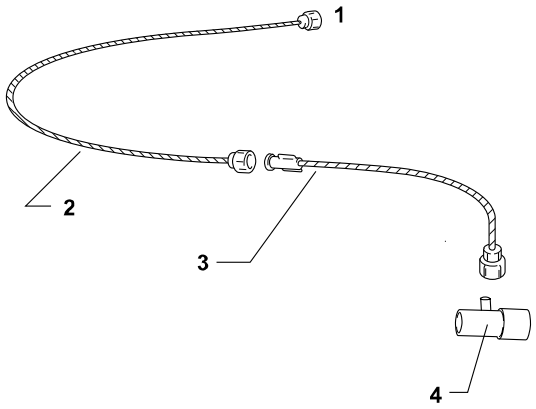
Setup Connections

- **CAUTION: Connect the sampling tube to the monitor before turning power ON. Failure to do so will cause the error message to be displayed.**
- **CAUTION: Firmly tighten each section when connecting because external air will be sucked in at any leaking connection, which will cause sample gas dilution lowering the measurement reading.**
- **CAUTION: Confirm the connector on the airway adaptor for the Nafion tube is facing up to prevent liquid from flowing in.**
- **CAUTION: The airway adaptor, Nafion tube and sampling tube are all consumables. It is recommended that they be replaced for each new patient. (Definitely change these components if the last patient having been examined had an infectious disease.)**

CAUTION: Be sure to dispose of discharged gas in order to prevent pollution of treatment room.

CAUTION: Do not reuse discharged gas in order to prevent the spread of infectious diseases.

1. Connect the sample line in the following manner:



1	To main unit	3	Nafion tube
2	Sampling tube	4	Airway adapter

Figure 44. Connecting the sample line

2. Check the volume of water in the water trap on the monitor's left panel.

Warming Up

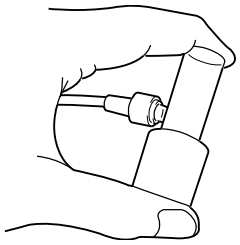
The monitor requires maximum of 3 minutes to warm up after the power has been turned on. After the warm-up has finished, auto atmosphere calibration will commence.

Sample Line Checks

WARNING: Do not use the device if the "Occlusion" message has not displayed after the sample line was seal-checked, as measurement readings will be incorrect.

Check to see that the sample gas is not diluted. If gas is diluted, measurement readings will be affected due to intake of external air from some point.

1. Seal both ends of the airway adaptor (see diagram below).
2. After a few seconds, check to see that the "Occlusion" message appears on screen and then unseal the ends of the airway adaptor.
3. Press the jog dial to return to normal measurement.



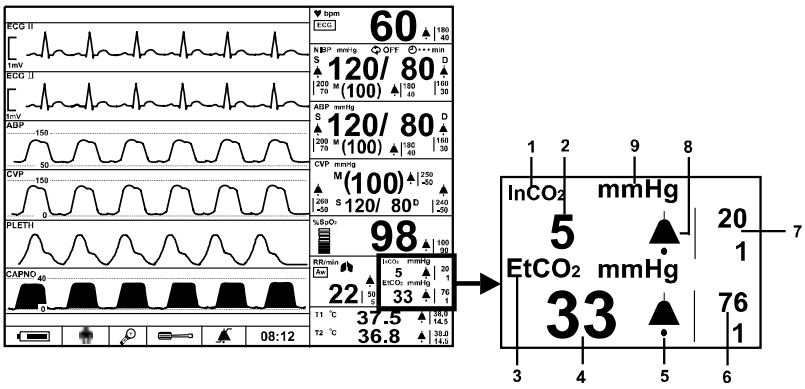
If the "Occlusion" message does not appear, there is probably a loose connection or leakage, so check each part of the setup.

Key points of attention:

✓ Occlude the inlet port of the water trap to see which side of the patient circuit may be the problem

✓ Also replace components to see if that solves the problem.

Description of CO_2 Menu Functions



1	$InCO_2$ icon	5	$EtCO_2$ alarm icon
2	$InCO_2$ value	6	$EtCO_2$ alarm limit values
3	$EtCO_2$ icon	7	$InCO_2$ alarm limit values
4	$EtCO_2$ value	8	$InCO_2$ alarm icon

Figure 45. CO_2 Display

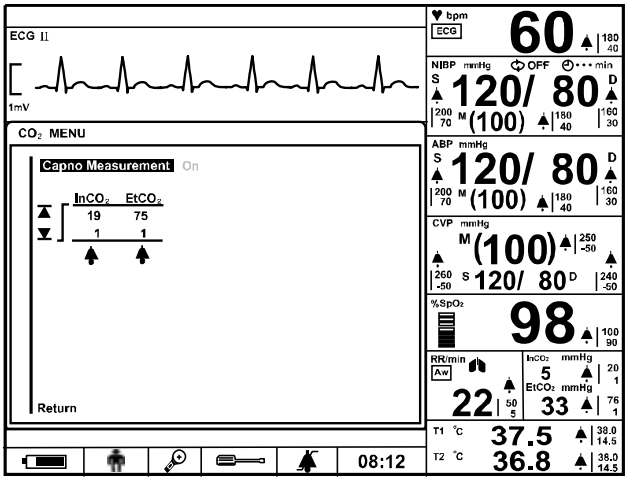


Figure 46. CO_2 Menu

Table 36. CO_2 Menu

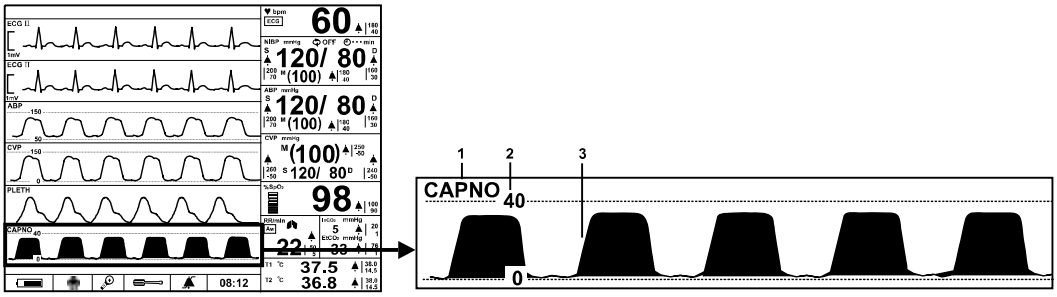
Level 1 Menu	Level 2 Menu or Response
CO_2 MENU	
Capno Measurement	On, Off
($InCO_2$ Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
$InCO_2$ Alarm Suspend	On, Off
($EtCO_2$ Alarm Limits Adjustment)	
▲	Upper Alarm Limit
▼	Lower Alarm Limit
$EtCO_2$ Alarm Suspend	On, Off
Return	

Note: The $EtCO_2$ and $InCO_2$ unit can only be changed by authorized personnel via ***Service menu***.

Capno Measurement

When the capno measurement is ***On***, $EtCO_2$, $InCO_2$ and capno waveform measurement are activated.

Description of Capno Waveform Menu Functions



1 Capno waveform icon
2 Capno scale bar
3 Capno waveform

Figure 47. Capno Waveform Display

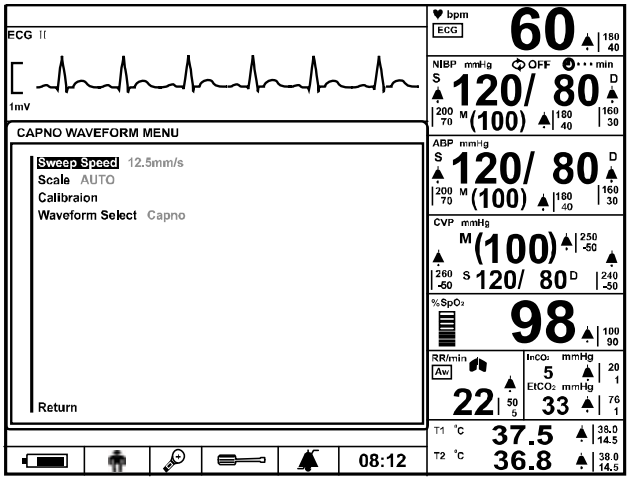


Figure 48. Capno Waveform Menu

Table 37. Capno Waveform Menu

Level 1 Menu	Level 2 Menu or Response
CAPNO WAVEFORM MENU	
Sweep Speed	6.25 mm/s, 12.5 mm/s, 25 mm/s
Scale	Auto, 0~40, 0~60, 0~80
Calibration	Yes, No
Waveform Select	ECG, Pleth, Respiration, (P1 Label), (P2 Label), Capno
Return	

Sweep Speed

The user-selectable sweep speed determines the speed at which Capno waveform trace moves across the screen. ***Sweep Speed*** can be selected from 6.25 mm/s, 12.5 mm/s and 25.0 mm/s, and the respiration waveform is synchronized with Respiration waveform.

Scale

The user can select the scale of capno waveform. When Auto is selected, the monitor will automatically set the scale upon the measurement value.

Calibration

Check gas concentration once a month or when the measurement reading seems dubious to ensure reliable measurement readings.
The selections required for this check are the optional designated calibration gas and pressure adjustment regulator.

1. Warming Up
The gas monitor's internal temperature must stabilize to ensure stable performance of the monitor. Therefore, wait for minimum 3 minutes to perform a gas calibration after turn on the power of the monitor.

CAUTION: When the calibration is not performed by the instructions stated in this section, the monitor could cause inaccurate measurement readings.

CAUTION: Perform the concentration check in an environment where the room temperature is 15ºC to 27 ºC to enhance calibration accuracy.

CAUTION: Move on to the next procedure when the "Warming up in progress" message disappears. If this message remains displayed, the sample line check cannot be performed and the gas calibration mode cannot be selected.

2. Calibration Gas Preparation
Prepare the optional designated calibration gas and the flowmeter, pressure adjustment instrument. Thoroughly check the component ratio of the calibration gas, as there are numerous types on the market.

CAUTION:
Calibration Gas Usage Cautions

- **Calibration gas must be used at between 15 ºC to 27 ºC (60 ºF to 80 ºF).**
- **The expiry date (EXP. DATE:) must printed on the calibration gas bottle. Do not use a calibration gas that has passed expiry date, as accuracy cannot be assured.**
- **When using calibration gas, be sure to use a surplus gas discharge device or thoroughly ventilate installation site.**
- **Do not breathe gas.**
- **Use with equipment rated for cylinder pressure.**

Calibration Gas Storage Cautions

- **Calibration gas must be stored at between 15 ºC to 27 ºC (60 ºF to 80 ºF).**
- **Exposure to temperature above 52 ºC (125 ºF) may cause contents to vent or cause bursting.**
- **Keep away from heat, including the sun, flame and sparks.**
- **Never discard container into fire or incinerator.**

3. Sample Line Checks
Check to see that the sample gas is not diluted. If gas is diluted, measurement readings will be affected due to intake of external air from some point. Refer to **Sample Line Checks** paragraph.

4. Connecting Calibration Gas
Connect the calibration gas cylinder and the flowmeter instead of the airway adapter to the sampling tube connected to the water trap

5. Accessing Calibration

Set ***Calibration*** in the capno waveform menu to ***Yes*** using the jog dial. The message "Calibration in progress" will appear.

6. Commencing Calibration Gas Flow

Once zero calibration has ended successfully, the message "Turn on CO_2 (10%) calibration gas." will appear. Commence calibration gas flow by turning the knob of the flowmeter. The flow rate should be between 130~170 ml/min. The message "Calibration gas detected" will appear.

7. Ending Calibration Gas

Once sampling is completed, the message "Please turn off CO_2 (10%) calibration gas" will appear. Turn off the calibration gas by turning the knob of the flowmeter.

If Gas Calibration Fails

If gas calibration fails while in progress, a screen like the following message will be displayed.

- ✓ Zero calibration range error
- ✓ Zero calibration signal unstable error.
- ✓ High calibration range error.
- ✓ High calibration signal unstable error.

In this case, gas calibration must be performed again, but before doing so, check the following selections.

- ✓ Is the correct calibration gas being used?
- ✓ Are connections loose?
- ✓ Is the calibration gas supply flow too low?
- ✓ Is the calibration gas supply flow too high?

TRENDS

General

Trend data in either graphical or tabular format may be displayed or printed if a recorder is installed. (see **Using the monitoring** section)

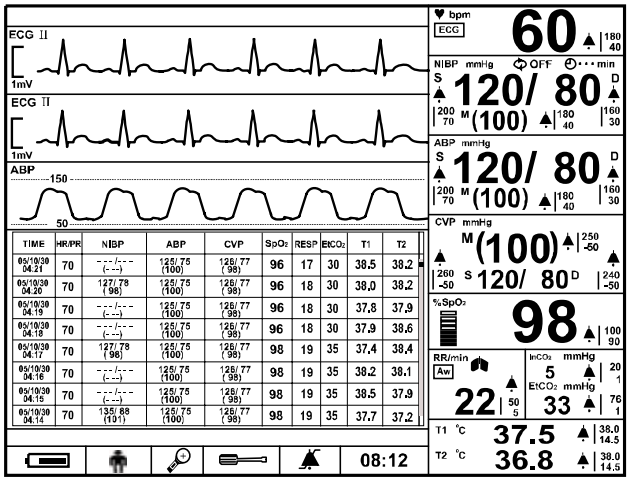
1. Press ***Trend button*** to display the tabular trends.
2. Press ***Trend button*** once again to display the graphical trends.
3. Press ***Trend button*** once again, or press ***Home button*** to return to the main screen

The trend data is stored in a memory. When the monitor turns on and starts to measure vital signs, the monitor saves data at a selected interval. Also, the monitor saves all physiological alarm conditions, NIBP measurement and error event. After the monitor has stored 1500 trend data, the monitor begins to store the new data over the oldest data.

Tabular Trend Data

The monitor presents trend information in tabular format for all monitored parameters. The newest data appears at the bottom of tabular trends. Use the scroll function to view more data. The gray bar at the right side of the trend screen presents the memory saved. The red point indicates the location of currently scrolling.

For the NIBP trends, the data may display the latest measurement.



TIME	HR/PR	NIBP	ABP	CVP	SpO2	RESP	EtCO2	T1	T2
05/10/30 04:21	70	---/--- (---)	125/ 75 (100)	125/ 77 (98)	96	17	30	38.5	38.2
05/10/30 04:20	70	127/ 78 (98)	125/ 75 (100)	125/ 77 (98)	96	18	30	38.0	38.2
05/10/30 04:19	70	---/--- (---)	125/ 75 (100)	125/ 77 (98)	96	18	30	37.8	37.9
05/10/30 04:18	70	---/--- (---)	125/ 75 (100)	125/ 77 (98)	96	18	30	37.9	38.6
05/10/30 04:17	70	127/ 78 (98)	125/ 75 (100)	125/ 77 (98)	98	19	35	37.4	38.4
05/10/30 04:16	70	---/--- (---)	125/ 75 (100)	125/ 77 (98)	98	19	35	38.2	38.1
05/10/30 04:15	70	---/--- (---)	125/ 75 (100)	125/ 77 (98)	98	19	35	38.5	37.9
05/10/30 04:14	70	135/ 88 (101)	125/ 75 (100)	125/ 77 (98)	98	19	35	37.7	37.2

Figure 49. Tabular Trend Screen

To scroll or change viewing options, push the jog dial on the tabular trend screen when the tabular trend screen is highlighted. The monitor displays the ***Tabular trend menu***.

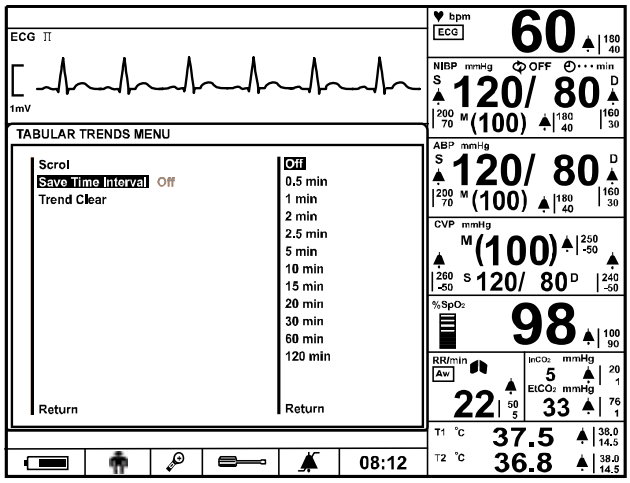


Figure 50. Tabular Trend Menu

Table 38. Tabular Trend Menu

Level 1 Menu	Level 2 Menu or Response
TABULAR TREND MENU	
Scroll	The jog dial is activated for scrolling. Note: Press the ***Home button*** to exit.
Save Time Interval	Off, 0.5, 1, 2, 2.5, 5, 10, 15, 20, 30, 60, 120 minutes
Trend Clear	Yes, No
Return	Exits ***Tabular trend menu*** immediately, returns to Tabular Trend Screen

Scrolling Tabular Trend Data

1. Rotate the jog dial to highlight ***Scroll***.
2. Press the jog dial to activate scrolling.
3. Rotate the jog dial to scroll through the trend data.
   Clockwise rotation moves forward to newer data. Counter clockwise rotation moves backward to older data.
4. After viewing the trends, press the jog dial to exit the scrolling.

Setting Save Time Interval

The monitor saves the trend data at the interval selected by user, and it displays all data stored when the tabular trend screen is activated. When ***Off*** is selected, the monitor stores trend data only when the NIBP measurement and the alarm condition occur.

Trend Clear

To clear trend data in the trend memory, set Trend Clear to ***Yes***.

Graphical Trend Data

Trend information in graphical format for all monitored parameters is displayed in one graph. The user can select each parameter to display via interaction with ***Graphical trend menu***.

The graphical trend data of each parameter is indicated by the symbols specified in table 3. The vertical range of a graphical trend is presented with fixed value, and the horizontal range is 90 minutes. The newest data appears at the right of graphical trend. Use the scroll function to view more data.

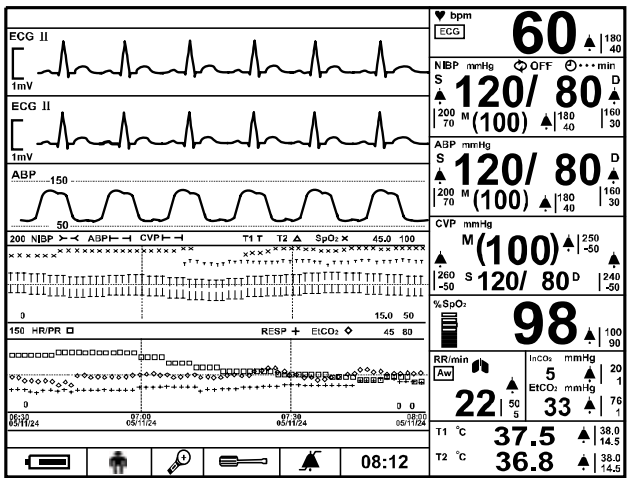


Figure 51. Graphical Trend Screen

To scroll or change viewing options, push the jog dial on the graphical trend screen when the graphical trend screen is highlighted. The monitor displays ***Graphical trend menu***.

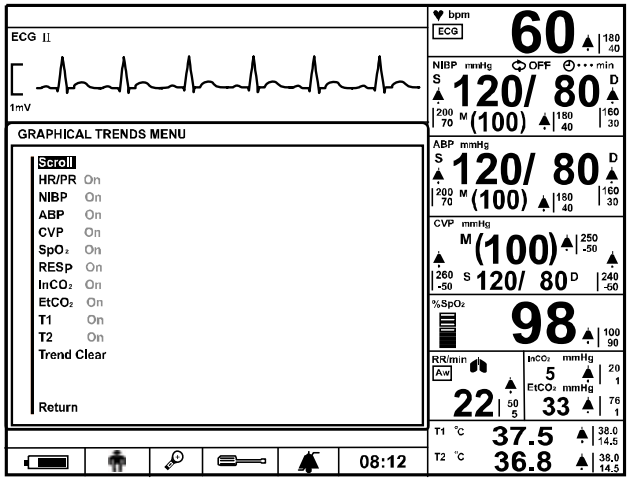


Figure 52. Graphical Trend Menu

Table 39. Graphical Trend Menu

Level 1 Menu	Level 2 Menu or Response
GRAPHICAL TREND MENU	
Scroll	The jog dial is activated for scrolling. Note: Press the ***Home button*** to exit.
HR/PR	On, Off
NIBP	On, Off
(Pl Label)	On, Off
(P2 Label)	On, Off
SpO_2	On, Off
RESP	On, Off
$EtCO_2$	On, Off
T1	On, Off
T2	On, Off
Trend clear	Yes, No
Return	*Exits **Graphical Trend Menu** immediately, returns to Graphical Trend Screen*

Selecting Graphical Trend Data

1. Rotate the jog dial to select ***HR/PR, NIBP, IBP1, IBP2, SpO_2, RESP, $EtCO_2$, T1 or T2, graphical trend***.
2. Press the jog dial to set to ***On***.
3. Rotate the jog dial to highlight ***Return***, then press the jog dial to return to the graphical trend screen. Only parameters set to ***On*** will be displayed in the graphical trend screen.

Note: Setting ***Off*** will not display the trends of the selected parameter.

Scrolling Graphical Trend Data

1. Rotate the jog dial to highlight ***Scroll***.
2. Press the jog dial to activate scrolling.
3. Rotate the jog dial to scroll through the trend data.
   Clockwise rotation moves forward to newer data. Counterclockwise rotation moves backward to older data.
4. After viewing the trends, press the jog dial to exit scrolling.

Trend Clear

To clear trend data in the trend memory, set ***Trend Clear*** to ***Yes***.

MENU STRUCTURE

ECG WAVEFORM MENU

- **ECG Cable Select**
  - **3 Leads**
  - **5 Leads**
  - **AUTO**
  - **Return**
- **Lead Select**
  - **I**
  - **II**
  - **III**
  - **aVR**
  - **aVL**
  - **aVF**
  - **V (Chest Lead)**
  - **Return**
- **Sweep Speed**
  - **12.5 mm/s**
  - **25.0 mm/s**
  - **50 mm/s**
  - **Return**
- **Size**
  - ▲ “Up”
  - ▼ “Down”
  - **Return**
- **Pacer Detect**
  - **On**
  - **Off**
- **Filter Mode**
  - **Monitor**
  - **Low Extend**
  - **Filter**
  - **Respiration Rejection**
  - **Return**
- **Waveform Select**
  - **ECG**
  - **Pleth**
  - **Respiration**
  - **(P1 Label)**
  - **(P2 Label)**
  - **Capno**
  - **Return**
- **Return**

PLETH WAVEFORM MENU

- **Sweep Speed**
- - **12.5 mm/s**
- - **25.0 mm/s**
- - **50.0 mm/s**
- - **Return**
- **Waveform Select**
- - **ECG**
- - **Pleth**
- - **Respiration**
- - **(P1 Label)**
- - **(P2 Label)**
- - **Capno**
- - **Return**
- **Return**

RESPIRATION WAVEFORM MENU

- **Sweep Speed**
- - **6.25 mm/s**
- - **12.5 mm/s**
- - **25.0 mm/s**
- - **Return**
- **Size**
- - ▲ “Up”
- - ▼ “Down”
- - **Return**
- **Waveform Select**
- - **ECG**
- - **Pleth**
- - **Respiration**
- - **(P1 Label)**
- - **(P2 Label)**
- - **Capno**
- - **Return**
- **Return**

(P1 LABEL) WAVEFORM MENU

- Sweep Speed
  - 12.5 mm/s
  - 25.0 mm/s
  - 50.0 mm/s
  - Return
- P1 Label
  - P1
  - ABP
  - Return
- P1 Scale
  - 0~50
  - 0~100
  - 0~200
  - 0~300
  - AUTO
  - Return
- Pressure Zero Setting
  - Yes
  - No
- Waveform Select
  - ECG
  - Pleth
  - Respiration
  - (P1 Label)
  - (P2 Label)
  - Capno
  - Return
- Return

(P2 LABEL) WAVEFORM MENU

- Sweep Speed
  - 12.5 mm/s
  - 25.0 mm/s
  - 50.0 mm/s
  - Return
- P2 Label
  - P2
  - CVP
  - PAP
  - LAP
  - Return
- P2 Scale
  - 0~20
  - 0~50
  - 0~100
  - 0~200
  - 0~300
  - Auto
  - Return
- Pressure Zero Setting
  - Yes
  - No
- Waveform Select
  - ECG
  - Pleth
  - Respiration
  - (P1 Label)
  - (P2 Label)
  - Capno
  - Return
- Return

CAPNO WAVEFORM MENU

- **Sweep Speed**
  - **6.25 mm/s**
  - **12.5 mm/s**
  - **25.0 mm/s**
  - **Return**
- **Scale**
  - **0~40**
  - **0~60**
  - **0~80**
  - **AUTO**
  - **Return**
- **Calibration**
  - **Yes**
  - **No**
  - **Return**
- **Waveform Select**
  - **ECG**
  - **Pleth**
  - **Respiration**
  - **(P1 Label)**
  - **(P2 Label)**
  - **Capno**
  - **Return**
- **Return**

Note: You can select the same waveform to display in two consecutive waveform areas.

HR/PR MENU

- **HR/PR Source**
  - **AUTO** *"ECG> IBP>SpO_2>NIBP"*
  - **HR** *"ECG"*
  - **PR** *"IBP>SpO_2>NIBP"*
  - **Return**

"Alarm limits adjustment/Alarm suspend setting"

- **HR/PR**

180

40

-

On

-

Off

- **Return**

NIBP MENU

- **Initial Inflation Pressure**
  - *"Adult"*
  - **120 mmHg**
  - **140 mmHg**
  - **160 mmHg**
  - **180 mmHg**
  - **200 mmHg**
  - **220 mmHg**
  - *"Neonatal"*
  - **80 mmHg**
  - **100 mmHg**
  - **120 mmHg**
  - **140 mmHg**
  - **Return**
- **BP On Alarm**
  - **On**
  - **Off**
- **Smart Clock**
  - **On**
  - **Off**
- **Completion Sound**
  - **On**
  - **Off**
- **Smart Inflation**
  - **On**
  - **Off**

"Alarm limits adjustment/Alarm suspend setting (mmHg)"

	SYS	MAP	DIA
	200	180	160
	70	40	30
-	On	On	On
-	Off	Off	Off

- **Return**

NIBP INTERVAL SETTING MENU

- **Automatic Mode Interval**
  - **Off**
  - **Cont**
  - **1 min**
  - **2 min**
  - **2.5 min**
  - **3 min**
  - **5 min**
  - **10 min**
  - **15 min**
  - **20 min**
  - **30 min**
  - **45 min**
  - **60 min**
  - **90 min**
  - **120 min**
  - **180 min**
  - **Return**

SpO_2 MENU

- **C-Lock**
  - **On**
  - **Off**

"Alarm limits adjustment/Alarm suspend setting"

- **SpO_2**

100

90

-

  On
-

  Off
- **Return**

(P1 LABEL) MENU

- **P1 Label**
- - **P1**
- - **ABP**
- - **Return**
- **Pressure Zero Setting**
- - **Yes**
- - **No**

“Alarm limits adjustment/Alarm suspend setting (mmHg)”

- **SYS MEAN DIA**

200 180 160

70 40 30

- **On On On**
- **Off Off Off**
- **Return**

(P2 LABEL) MENU

- **P2 Label**
- - **P2**
- - **CVP**
- - **PAP**
- - **LAP**
- - **Return**
- **Pressure Zero Setting**
- - **Yes**
- - **No**

“Alarm limits adjustment/Alarm suspend setting (mmHg)”

- **SYS MEAN DIA**

200 180 160

70 40 30

- **On On On**
- **Off Off Off**
- **Return**

RESPIRATION MENU

- **Respiration/Apnea**
  - **Off**
  - **AUTO**
  - **awRR**
  - **imRR**
  - **Return**
- **Apnea Time Setting** *"40 sec preset for loss of respiration"*
  - **Off**
  - **20 sec**
  - **30 sec**
  - **40 sec**
  - **60 sec**
  - **Step 60**
  - **Step 90**
  - **Return**

"Alarm limits adjustment/Alarm suspend setting"

- **RESP**

30

0

-

On

-

Off

- **Return**

CO_2 MENU

- **Capno Measurement**
  - **On**
  - **Off**

"Alarm limits adjustment/Alarm suspend setting (mmHg)"

	$InCO_2$	**$EtCO_2$**
	20	**80**
	0	**0**
-	**On**	**On**
-	**Off**	**Off**

- **Return**

TEMPERATURE MENU

“Alarm limits adjustment/Alarm suspend setting (ºC)”

	T1	T2
	38.0	38.0
	14.5	14.5
-	On	On
-	Off	Off
-	Return	

TABULAR TREND MENU

- Scroll
- Save Time Interval
  - Off
  - 0.5 min
  - 1 min
  - 2 min
  - 2.5 min
  - 5 min
  - 10 min
  - 15 min
  - 20 min
  - 30 min
  - 60 min
  - 120 min
  - Return
- Trend Clear
  - Yes
  - No
- Return

GRAPHICAL TREND MENU

- **Scroll**
- **HR/PR**
- - **On**
- - **Off**
- **NIBP**
- - **On**
- - **Off**
- **(P1 Label)**
- - **On**
- - **Off**
- **(P2 Label)**
- - **On**
- - **Off**
- **SPO_2**
- - **On**
- - **Off**
- **RESP**
- - **On**
- - **Off**
- **$EtCO_2$**
- - **On**
- - **Off**
- **T1**
- - **On**
- - **Off**
- **T2**
- - **On**
- - **Off**
- **Trend Clear**
- - **Yes**
- - **No**
- **Return**

DATE/TIME MENU

- **Date**
- - **YYYY**
- - **MM**
- - **DD**
- **Time**
- - **HH** *"24 hours only"*
- - **MM**
- **Return**

SETUP MENU

- Patient Mode
  - Adult
  - Neonatal
  - Return
- Record Speed
  - 25 mm/s
  - 50 mm/s
  - Return
- Wave Record Time
  - 20 sec
  - Continuous
  - Return
- Wave Record Select
  - ECG 1 + ECG 2
  - ECG 1 + PLETH
  - ECG 1 + RESP
  - ECG 1 + (P1 Label)
  - ECG 1 + (P2 Label)
  - ECG 1+ CAPNO
  - Return
- Record On Alarm
  - On
  - Off
- Auto List Record
  - On
  - Off
- Alarm Volume
  -
- HR/PR Tone Volume
  -
  - Off
- Key Beep Volume
  -
  - Off
- Sleep Mode
  - Off
  - 10 min
  - 20 min
  - 30 min
  - Return
- Main Screen
  - 4-ch Wave
  - 6-ch Wave
  - Big Number
  - Return
- Service Menu
  - Pass Code
  - Return

ALARM LIMITS MENU

- **Record On Alarm**
- - **On**
- - **Off**
- **Audible Alarm Silence Period** *"The current setting is shown only.*
- - **30 sec** *This period may be set via **Service menu**"*
- - **60 sec**
- - **90 sec**
- - **120 sec**
- **Audible Alarm Suspend Period** *"The current setting is shown only.*
- - **Off** *This period may be set via **Service menu**"*
- - **10 min**
- - **20 min**
- - **30 min**
- - **60 min**
- - **Indefinite**
- **Alarm Limits** *"Alarm limits adjustment/Alarm suspend setting"*

	HR/PR	SPO_2	RESP	$InCO_2$	$EtCO_2$	T1	T2
	180	100	30	20	80	38.0	38.0
	40	90	0	0	0	14.5	14.5
- -	On	On	On	On	On	On	On
- -	Off	Off	Off	Off	Off	Off	Off

	NIBP			(P1 Label)			(P2 Label)		
	SYS	MAP	DIA	SYS	MEAN	DIA	SYS	MEAN	DIA
	200	180	160	200	180	160	200	180	160
	70	40	30	70	40	30	70	40	30
- -	On			On			On		
- -	Off			Off			Off		

- - **Return**
- **Alarm Limits Display**
- - **On**
- - **Off**
- **Auto Alarm**
- - **On**
- - **Off**
- **Auto Alarm Setting** *"% setting for each parameter"*

	HR/PR	SpO_2	RESP	$InCO_2$	$EtCO_2$	T1	T2
	40%	40%	40%	40%	40%	40%	40%
	-20%	-20%	-20%	-20%	-20%	-20%	-20%

	NIBP			(P1 Label)			(P2 Label)		
	SYS	MAP	DIA	SYS	MEAN	DIA	SYS	MEAN	DIA
	40%	40%	40%	40%	40%	40%	40%	40%	40%
	-20%	-20%	-20%	-20%	-20%	-20%	-20%	-20%	-20%

- - **Return**
- **Return**

Note: Alarm limits shown above are for Adult patient mode. In order to set alarm limits to Neonatal patient mode, change Patient mode via ***Setup menu***.

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PRINTING

General

The monitor can print real-time measurement and trend data as follows.

1. Set ***Record Speed, Wave Record Time, Wave Record Select, Record on Alarm, Auto List Record*** via ***Setup menu*** (refer Table 11).
2. To start printing, press ***Record button***.
3. To stop printing during print out, press ***Record button*** again.

Record Speed

The record speed for is user-selectable: either 25.0 or 50.0 mm/s. When 50.0 mm/s is selected, the wave record time is fixed to 20 sec.

Wave Record Time

20 sec
A 20-second print, recording real-time graphical and numeric information beginning 10 seconds before the print initiation and ending 10 seconds after that event.

Continuous
A print of real-time graphical and numeric information, beginning 10 seconds before initiating the action and continuing until stopped.

Wave Record Select

The monitor prints out the real-time waveforms selected by the user.
- ECG 1+ ECG 2
- ECG 1+ PLETH
- ECG 1+ RESP
- ECG 1+ IBP 1
- ECG 1+ IBP 2
- ECG 1 + CAPNO

Record On Alarm

If ***Record on alarm*** is set to ***On*** in ***Setup menu***, the monitor will automatically print out whenever a physiological alarm condition occurs.

Auto list record

If the Auto List Record is ***On***, 8 data recorded in trend memory will be automatically printed out.

Print Out Configuration

20 Sec Print Out

If ***Wave record time*** is set to ***20 sec***, the monitor will print out numeric data and waveforms by pressing ***Record button*** as shown Figure 53

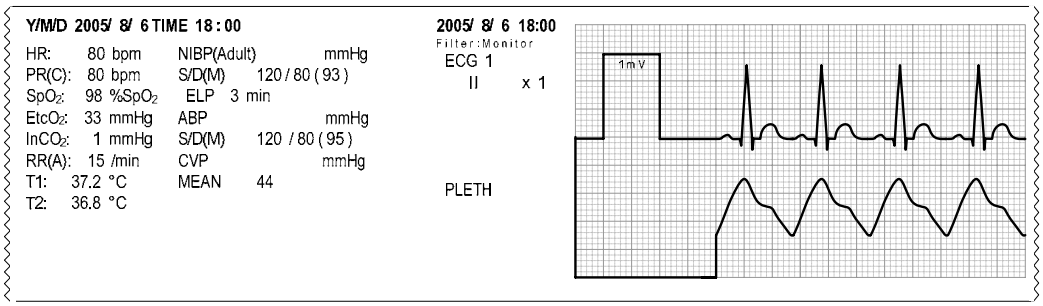

Figure 53. 20 Sec Printing

Continuous Print Out

If ***Wave record time*** is set to ***Continuous***, the monitor will print out numeric data every minute and waveforms continuously by pressing the ***Record button*** as shown in Figure 54.

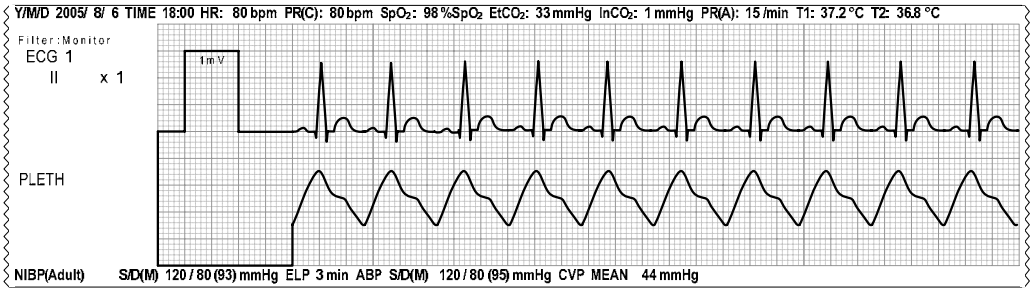
Y/M/D 2005/ 8/ 6 TIME 18:00 HR: 80 bpm PR(C): 80 bpm SpO2: 98 %SpO2 EtCO2: 33 mmHg InCO2: 1 mmHg PR(A): 15 /min T1: 37.2 °C T2: 36.8 °C
Filter:Monitor
ECG 1
II x 1
PLETH
1mV
NIBP(Adult) S/D(M) 120 / 80 (93) mmHg ELP 3 min ABP S/D(M) 120 / 80 (95) mmHg CVP MEAN 44 mmHg

Figure 54. Continuous Printing

Tabular Trend Data Print Out

When tabular trend data is displayed on the screen, the monitor will print out the displayed data by pressing the ***Record button*** as shown in Figure 55.

TIME YY/MM/DD	HR/PR [BPM]	NIBP [mmHg]	ABP [mmHg]	CVP [mmHg]	SpO_2 [%SpO_2]	RESP [/min]	$EtCO_2$ [mmHg]	T1 [°C]	T2 [°C]
05/ 8/ 6 18 : 00	80	- - -/- -(- -)	118/84(93)	120/80(93)	94	25	35	38.5	37.5
05/ 8/ 6 18 : 02	88	- - -/- -(- -)	118/72(96)	128/82(96)	95	18	32	38	38.2
05/ 8/ 6 18 : 02	74	- - -/- -(- -)	119/79(98)	109/89(95)	95	18	80↑	37.7	38.4
05/ 8/ 6 18 : 04	74	- - -/- -(- -)	124/72(89)	114/72(90)	92	17	31	38.2	38.1
05/ 8/ 6 18 : 04	80	- - -/- -(- -)	104/71(82)	114/51(80)	80↓	19	20	38.1	38.6
05/ 8/ 6 18 : 06	75	- - -/- -(- -)	111/74(81)	112/76(82)	91	17	25	37.8	37.8
05/ 8/ 6 18 : 06	74	102/68(83)	108/78(85)	118/68(85)	91	16	30	38.0	38.4
05/ 8/ 6 18 : 08	76	- - -/- -(- -)	111/62(84)	118/63(85)	95	20	31	37.9	37.6

Figure 55. Tabular Trend Printing

Graphical Trend Data Print Out

When graphical trend data is displayed on the screen, the monitor will print out the displayed data by pressing the ***Record button*** as shown in Figure 56.

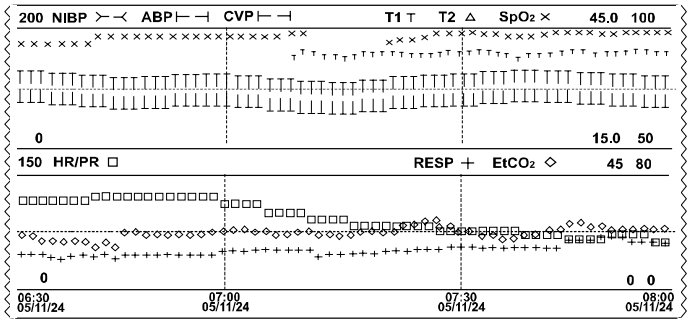

Figure 56. Graphical Trend Printing

Setting Information Print Out

The monitor can print out all internal settings by selecting ***Print value of configuration*** in ***Service menu*** as shown in Figure 57. Refer to the service manual for the detailed instructions.

Y/M/D 2005/ 8/ 6	TIME 18:00	P1 Scale	AUTO	BO On Alarm	Off	-CVP MENU-		Alarm ($InCO_2$)	20 / 0		
-ECG WAVE MENU-		-CVP WAVE MENU-		Smart Clock	On	Alarm (SYS)	200 / 70	Alarm ($EtCO_2$)	80 / 0		
ECG Cable Select	AUTO	Sweep Speed	25.0mm/s	Completion Sound	On	Alarm (MEAN)	180 / 40	-TEMPERATURE MENU-			
Sweep Speed	25.0mm/s	P1 Label	CVP	Smart Inflation	On	Alarm (DIA)	160 / 30	Alarm (T1)	38.0 / 14.5		
Pacer Detect	Off	P2 Scale	AUTO	Alarm (SYS)	200 / 70	-SpO_2 MENU-		Alarm (T2)	38.0 / 14.5		
Filter Mode	Monitor	-CAPNO WAVE MENU-		Alarm (MEAN)	180 / 40	C-Lock	Off	-ALARM LIMITS MENU-			
-PLETH WAVE MENU-		Sweep Speed	12.5mm/s	Alarm (DIA)	160 / 30	Alarm	100 / 90	Record On Alarm	Off		
Sweep Speed	25.0mm/s	Scale	AUTO	-NIBP INTERVAL SETTING MENU-		-RESPIRATION MENU-		Audible Alarm Silence Period			
-REPIRATION WAVE MENU-		-HR/PR MENU-		Interval	Off	Respiration/Apnea	AUTO		120 sec		
Sweep Speed	12.5mm/s	HR/PR Source	AUTO	-ABP MENU-		Apnea Time Setting	40 sec	Audible Alarm Suspend Period			
-ABP WAVE MENU-		Alarm	180 / 40	Alarm (SYS)	200 / 70	Alarm	30 / 0		Indefinite		
Sweep Speed	25.0mm/s	-NIBP WAVE MENU-		Alarm (MEAN)	180 / 40	-CO_2 MENU-		Alarm Limits Display			
P1 Label	ABP	Initial Inflate	180	Alarm (DIA)	160 / 30	Capno Measurement	On		On		

Auto Alarm	Off	ABP (MEAN)	40% / -20%	RESP	On	Key Beep Volume	4	Unit of Temp	°C
Auto Alarm Setting(%)		ABP (DIA)	40% / -20%	$EtCO_2$	On	Sleep Mode	Off	Language Setting	English
HR/PR	40% / -20%	CVP (SYS)	40% / -20%	T1	On	-SERVICE MENU-		Date Format	Year/Month/Day
SpO_2	40% / -20%	CVP (MEAN)	40% / -20%	T2	On	Save Settings On Power Off		Demo Mode	Off
RESP	40% / -20%	CVP (DIA)	40% / -20%	-SETUP MENU-			Back Up		
$InCO_2$	40% / -20%	-TABULAR TRENDS MENU-		Patient Mode	Adult	Audible Alarm Silence Period			
$EtCO_2$	40% / -20%	Save Time Interval 0.0 min		Record Speed	25 mm/s		120 sec		
T1	40% / -20%	- GRAPHICAL TRENDS MENU-		Wave Record Time	Continuous	Audible Alarm Suspend Period			
T2	40% / -20%	HR/PR	On	Wave Record Time	ECG1 + PLETH		Indefinite		
NIBP (SYS)	40% / -20%	NIBP	On	Record On Alarm	Off	AC Line Frequency	60Hz		
NIBP (MAP)	40% / -20%	ABP	On	Auto List Record	Off	Unit of NIBP	mmHg		
NIBP (DIA)	40% / -20%	CVP	On	Alarm Volume	5	Unit of IBP	mmHg		
ABP (SYS)	40% / -20%	SpO_2	On	HR/PR Tone Volume	4	Unit of CO_2	mmHg		

Figure 57. Setting Information Printing

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EXTERNAL INTERFACE

General

The monitor provides external connectors on the right panel to support communication with external equipment and functions such as a nurse call, software upgrades or PC connection.

WARNING: Any connections between this monitor and other devices must comply with applicable medical systems safety standards such as IEC 60601-1. Failure to do so could result in unsafe leakage current and grounding conditions.

Note: This equipment is to be used on a network and the communication wirings (RJ45 LAN and RS232) are limited to inside of the building.

Cable Connections

RS-232

The pin layouts of 15-pin RS-232 interface are illustrated below.

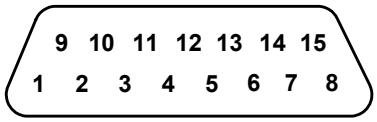

Figure 58. Data Port Pin Layout

Table 40. RS-232 Serial Interface Connections

Pin #	Signal
1	Not used (open)
2	RS232 RX
3	RS232 TX
4	not used (open)
5	RS232 ground
6	not used (open)
7	Nurse call normally open
8	Nurse call normally closed
9	not used (open)
10	RS232 ground
11	not used (open)
12	not used (open)
13	not used (open)
14	not used (open)
15	Nurse call common

Nurse Call Interface

WARNING: The nurse call feature should not be used as the primary source of alarm notification. The audible alarms of the monitor, used in conjunction with clinical signs and symptoms, are the primary sources for notifying medical personnel that an alarm condition exists.

CAUTION: The nurse call feature is not functional whenever the monitor alarms are silenced.

CAUTION: The nurse call function needs to be tested after it has been set up in your facility. The nurse call feature should be tested whenever setting up the BP-S510 in a location that uses nurse call. One way to test the nurse call function is to create an alarm condition (for example, sensor disconnect) and verify that your facility's nurse call system is activated.

The nurse call feature of the monitor is operational when the monitor is powered by AC power or battery power. The nurse call feature of the monitor works in conjunction with the nurse call system of your institution when the monitor sounds an audible alarm.

The monitor provides the nurse call interface of relay closure type. The interface functions when the monitor is operating either on AC power or battery power.

The remote location is signaled anytime there is an audible alarm. If the audible alarm has been turned off or silenced, the nurse call function is also turned off.

Nurse Call Relays Normally Open/Closed

Pins 7 and 15 provide a relay that closes when an alarm is sounding on the monitor. Pins 8 and 15 provide a relay that opens when an alarm is sounding. Pin 15 is a common lead for both relays.

MAINTENANCE

⚠	**WARNING: The cover should be removed only by qualified service personnel. There are no internal user-serviceable parts except for the battery.**
⚠	**WARNING: Do not spray, pour, or spill any liquid on the monitor, its accessories, connectors, switches or openings in the chassis.**
⚠	**WARNING: Unplug the power cord from the monitor before cleaning the monitor.**

Recycling and Disposal

When the monitor, battery, or accessories reach the end of useful life, recycle or dispose of the equipment according to appropriate local and regional regulations.

Note: The monitor should be disposed of separately from the municipal waste stream via designated collection facilities appointed by the government or the local authorities.

Note: The correct disposal of your old appliance will help prevent potential negative consequences for the environment and human health.

Note: For more detailed information about disposal of your old appliance, please contact your city office, waste disposal service or the shop where you purchased the monitor.

Returning the Monitor and System Components

Pack the monitor with sensors, cable or other accessory items in its original shipping carton. If the original carton is not available, use a suitable carton with appropriate packing material to protect the monitor during shipping.

Service

The monitor requires no routine service other than cleaning, battery maintenance, and service activity which is mandated by the user's institution. For more information, refer to the monitor service manual. Qualified service personnel in the user's institution should perform periodic inspections of the monitor. If service is necessary, contact qualified service personnel or your local supplier.

Periodic Safety Checks

It is recommended that the following checks be performed every 24 months.

- Inspect the equipment for mechanical and functional damage.
- Inspect the external safety labels for legibility.

Cleaning

The monitor may be surface-cleaned by using a soft cloth dampened with either a commercial, nonabrasive cleaner or one of the solution listed in the below. Lightly wipe the top, bottom and front surfaces of the monitor lightly.

- 70% Isopropyl alcohol
- 10% Chlorine bleach solution

For cables, sensors, cuffs, and probes, follow the cleaning instructions in the directions for use shipped with those components.

Avoid spilling liquid on the monitor, especially in connector areas. If liquid is accidentally spilled on the monitor, clean and dry thoroughly before reuse. If in doubt about monitor safety, refer the unit to qualified service personnel for checking.

Battery Maintenance

CAUTION: Recharging the battery is strongly recommended when the battery has not been recharged for 2 or more months.

CAUTION: Follow local government ordinances and recycling instructions regarding disposal or recycling of device components, including batteries.

If the monitor has not been used 2 months, the Ni-MH battery will need charging. To charge the battery, connect the monitor to an AC power source as described in the **Battery Operation** section.

Note: Storing the monitor for a long period without charging the battery may degrade the battery capacity. A full charge of a depleted battery takes over 12 hours

Note: The service menu displays the number of deep discharge cycles seen by the battery. The monitor records a deep discharge cycle when the battery reaches the voltage at which a “Critically low battery” alarm is issued. Refer to the service manual for the details.

Note: The battery should be removed from the monitor if placed in storage or will not be used for a long period.

Colin Medical Technology recommends that the monitor’s Ni-MH battery be replaced if it has been stored for 2 years or more. Refer to the monitor service manual for battery replacement and general service instructions.

Loading Recorder Paper

CAUTION: Use only recorder paper specified by Colin Medical Technology.

Note: The paper roll is easier to load if it is held horizontally with your thumb on top and your forefinger and/or index finger underneath it.

Load recorder paper as follows:

1. Open the recorder door by pulling the latch on the recorder slightly and carefully. The door should tilt open. Gently pull the door open if necessary.
2. Reach in and remove the empty paper core by pulling it over gently with your thumb and index finger.
3. Insert a new paper roll oriented properly.
4. Pull the paper out towards you until approximately 2 inches (5 cm) of paper have been unrolled.
5. Align the paper with the pinch roller attached to the recorder door.
6. Close the recorder door.

Note: To make sure that the paper is aligned in the slot and has not been pinched in the door, pull the loose edge until a few inches of paper is showing. If the paper will not move, open the door and return to step 4.

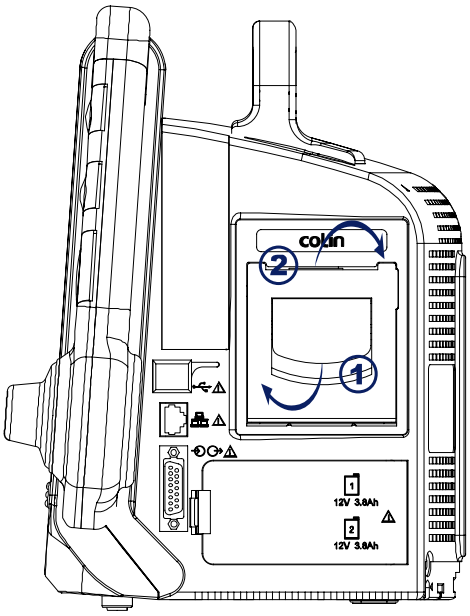

Figure 59. Recorder Paper Replacement

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TROUBLESHOOTING

WARNING: If you are uncertain about the accuracy of any measurement, check the patient's vital signs by alternate means; then make sure the monitor is functioning correctly.

WARNING: The cover should be removed only by qualified service personnel. There are no user-serviceable parts inside except for the battery.

General

If the monitor detects an error, it can display an error code. The error codes are listed in the monitor service manual. If an error code is displayed, write down the code and contact your service department. Before calling your local supplier, make sure that the battery is charged and that all power connections are in place.

Corrective Action

If you experience a problem while using the monitor and are unable to correct it, contact qualified service personnel or your local supplier. The service manual provides additional troubleshooting information for qualified personnel.

Following is a list of possible errors and suggestions for corrective action.

1. There is no response to the Power on/off button.

- A fuse may be blown. Notify service personnel to check and replace the fuse.
- If operating on battery power, the battery may be missing or discharged. If the battery is discharged, charge the battery (see **Battery Operation** section).

2. The monitor screen does not function properly and the power-on beep tones do not sound during the power-on self test.

- Do not use the monitor; contact qualified service personnel or your local supplier.

3. The monitor is operating on battery power, even though it is connected to AC.

- Make sure that the power cord is properly connected to the monitor.
- Check to see if power is available to other equipment on the same AC circuit.
- The monitor operates from its internal battery if there is no AC power source.

4. When the alarm condition occurs, check the following items.

- Check the alarm message in the alarm message area or informative message area.
- Follow the check items in the below table to remove the alarm condition

Alarm Messages	Check Items
NIBP: Check cuff (C11)	Cuff pressure did not increase enough even after activating the pump for more than 30 seconds (adult). There is a possibility that a cuff hose is disconnected, or a cuff may not be wrapped around an arm. Check cuff and cuff hose. This error possibly occurs in case of large cuffs that are wrapped around loosely. When the error still occurs even after checking above, there is a possible air leakage from a ruptured cuff. Replace it with a new one.
NIBP: Check cuff / Patient (C12)	Blood pressure could not be measured even after cuff pressure decreased. It is possibly because pulse was not strong enough for measurement, or because change of pulse amplitude could not be

Alarm Messages	Check Items
	obtained. Check whether cuffs are not wrapped around thick clothing. After wrapping cuffs around property, measure again. When the error occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Cuff excessive artifact (C13)	Measurement failed because of patient movement during measurement. Tell the patient to stay still, then, measure again. When it occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Cuff insufficient pressure (C14)	Measurement failed because of insufficient pressurizing. There is a possibility that standard cuff pressure might be detected wrongly due to noises, motion artifact or external vibration. Check whether cuffs are not wrapped around thick clothing, whether the patient is moving and whether cuffs are free from outside vibrations, then, measure again. When it occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Cuff irregular pulses (C15)	Blood pressure could not be measured because oscillation graph was not normal. There is a possibility that motion artifact or vibration from outside might interrupt the measurement. Check whether the patient stays still and cuffs are free from external vibration, then, measure again. When it occurs in the initial measurement in continuous mode, the second measurement is continued unless Stop button is pressed.
NIBP: Cuff motion artifact (C16)	Blood pressure could not be measured because noises interrupted pulse waveform signal. Check for motion artifacts, or external vibration and then, measure again. When it occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Cuff time-out (C17)	Measurement was preventively stopped because measurement time exceeded 160 seconds (adult), There is a possibility that blood pressure might be repeatedly measured due to insufficient pressurizing caused by calcified pseudohypertension.
NIBP: Cuff time-out, over 160 pulses (C18)	Pulse waveform signal more than 160 beats are detected during measurement. There is possibility that noises might interrupt signal. Motion artifact or external vibrations possibly affected cuffs. Check for patient movement and if the cuff is free from stays still and cuffs are free from outside vibration, then, measure again.
NIBP: Cuff pressure failure (C19)	Cuff pressure exceeded more than 300 mmHg (adult) during measurement. There is a possibility that the patient moved during measurement or strong pressure from outside might be added to cuffs. Considering above, measure again.
NIBP: Cuff weak pulse (C20)	Amplitude of pulse obtained from cuffs are too weak. This error possibly occurs when cuffs are wrapped around loosely in ASO patients or when cuffs are wrapped around thick clothing. Wrap cuffs around properly, then, measure again.
NIBP: Check cuff, hose and mode (C21)	Patient to be measured, and cuff size used, do not match. This error may occur if the blood pressure measurement mode setting is incorrect, if the cuff has been wrapped tightly in the adult mode, loosely in the neonatal mode or if the arm has been bent during measurement. Check the measurement mode setting and application of the cuff, and measure again.

Alarm Messages	Check Items
NIBP: Internal error (E03)	NIBP module error BPM pressure sensor fault. Pump operated for ten seconds, however pressure does not change. Check the connection of the cuff hose.
NIBP: Internal error (E07)	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local supplier.
NIBP: Internal error (E08)	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local supplier.
NIBP: Internal error (E09)	NIBP module error Fault detected in accordance with safety monitoring to BPM IEC standards. The pressure inside the cuff reaches the standard pressure. Standard pressure Adult: 320mmHg Neonatal: 157mmHg
NIBP: Internal error (ROM)	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local suppler.
NIBP: Internal error (RAM)	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local suppler.
NIBP: Internal error (COM)	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local suppler.
ECG: Internal error.	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local suppler.
RESP: Internal error.	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local suppler.
{label}: Loss of pulse.	Check the condition of the patient and fitting of the transducer and cable, and measure again.
IBP: Internal error.	Verify that the IBP module is correctly installed after the BP-S510 is powered off. If the problem persists, reboot the monitor.
SpO_2: Loss of pulse.	Signal obtained from sensor is weak. SpO_2 could not be measured. There may be a problem with fitting of the SpO_2 sensor, or blood flow at the sensor site may be unsatisfactory. Check the condition of the patient and fitting of the sensor, and measure again.
SpO_2: Internal error.	A problem with the SpO_2 measurement has been detected. The SpO2 measurement function does not operate. If switching power OFF/ON has no effect it is possible that a fault has occurred. Stop using the monitor immediately and contact qualified service personnel or your local suplier.
TEMP*{n}*: Internal error.	An internal circuit fault has been detected. If switching power OFF/ON has no effect it is possible that a fault has occurred in the monitor. Cease use immediately.
CAPNO: Internal error.	A problem with the capnography measurement function has been detected. The capnography measurement function does not operate. If switching power OFF/ON has no effect it is possible that a fault has occurred. Cease use immediately.
CAPNO: Sensor error.	The connector may be damaged or a fault may have occurred within the gas unit or main unit. Cease use immediately.
SYSTEM: Critically low-battery condition.	Connect the AC power cord of the monitor to the AC main to recharge the battery.
SYSTEM: Real time clock error.	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local supplier.
SYSTEM: WDT error.	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local supplier.
SYSTEM: RAM error.	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local supplier.

Alarm Messages	Check Items
SYSTEM: Failure.	Reboot the monitor. If the problem persists, cease use immediately and contact qualified service personnel or your local supplier.
ECG : Check ECG leads & electrodes.	ECG error is detected, Electrodes or lead wires may not be correctly attached or a circuit is possibly saturated due to offset voltage. Check whether electrodes are correctly attached and electrodes are new and wet. Confirm the patient's skin is clean.
{label}: Cable/Sensor disconnected.	Cable not connected to the main unit. If connected, the cable may be damaged. Replace with a new cable. If replacing the cable has no effect the problem may be within the device. In this case, cease use immediately.
SpO_2: Check probe.	Sensor is not in contact with patient. SpO_2 could not be measured. Fit the sensor correctly to the patient, and measure again.
TEMP*{n}*: Temperature probe disconnected.	Sensor not connected to the main unit. If connected, the cable may be damaged. Replace with a new cable. If replacing the cable has no effect the problem may be within the device. In this case, cease use immediately.
CAPNO: Occlusion.	Check the patient condition.
CAPNO: Water trap full.	Disconnect the sampling tubing from the water trap and replace the water trap with a new one.
ECG: Signal saturation.	Decrease the ECG size via the setup menu.
RESP: Check Resp leads & electrodes.	Electrodes or lead wires may not be correctly attached or a circuit is possibly saturated due to offset voltage. Check whether electrodes are correctly attached and electrodes are new and wet. Confirm the patient's skin is clean.
{label}: Unable to zero calibration.	Could not zero calibrate pressure. Check that the transducer is open to the atmosphere, and check the three-way tap. As it is also possible that the measured pressure incorporates noise, check the measurement circuit.
{label}: Out of range.	A value outside the measurement range was obtained. As the transducer has been subject to abnormal pressure, check the measurement circuit.
SpO_2: Check sensor.	Sensor not connected. If connected, the cable or connector may be damaged. Replace with a new cable. If replacing the cable has no effect the problem may be within the device. In this case, cease use immediately.
SpO_2: Sensor failure.	A problem with the SpO_2 sensor has been detected. The SpO_2 measurement function does not operate. The possible cause is a connection failure of the SpO_2 sensor and the extension cable, or a failure of the sensor or cable. Reconnect the sensor and extension cable or replace them with new ones. If the problem doesn't clear up after carrying out the remedies above or switching power OFF/ON, a grave fault can develop, Cease the use of the sensor immediately.
SpO_2: Module reset.	A problem with the SpO_2 measurement has been detected. The SpO_2 measurement function does not operate. If switching power OFF/ON has no effect it is possible that a fault has occurred. Cease use immediately.
TEMP*{n}*: Out of range.	A measure reading outside the measurement range was obtained. It is possible that the temperature in the vicinity of the sensor is extremely low (less than 15.0°C) or extremely high (more than 45.0°C). Adjust the ambient temperature and measure again.
CAPNO: Zero calibration range error	Try again the gas calibration.

Alarm Messages	Check Items
CAPNO: Zero calibration signal unstable error	Try again the gas calibration.
CAPNO: High calibration range error	Try again the gas calibration.
CAPNO: High calibration signal unstable error	Try again the gas calibration.
SYSTEM: Low battery.	Plug the AC power cord to the AC main to recharge the battery.
NIBP: Retry, Check cuff/Patient (C12)	Blood pressure could not be measured even after cuff pressure decreased. It is possibly because pulse was not strong enough for measurement, or because change of pulse amplitude could not be obtained. Check whether cuffs are not wrapped around thick clothing. After wrapping cuffs around properly, measure again. When the error occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Retry, Cuff excessive artifact (C13)	Measurement failed because of patient movement during measurement. Tell the patient to stay still, then, measure again. When it occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Retry, Cuff insufficient pressure (C14)	Measurement failed because of insufficient pressurizing. There is a possibility that standard cuff pressure might be detected wrongly due to noise, patient movement or external vibrations. Check whether cuffs are not wrapped around thick clothing, whether the patient is moving and whether there is external vibration. When it occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Retry, Cuff irregular pulses (C15)	Blood pressure could not be measured because oscillation graph was not normal. There is a possibility that patient movement or external vibration interrupted the measurement. Check whether a patient stays still and cuffs are free from outside vibrations, then, measure again. When it occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Retry, Cuff motion artifact (C16)	Blood pressure could not be measured because noises interrupted pulse waveform signal. There is a possibility that patient movement or external vibration interrupted the measurement. Confirm the patient is not moving and the cuff is free of external vibration, then, measure again. When it occurs in the initial measurement in continuous mode, the second measurement will start unless Stop button is pressed.
NIBP: Retry, Cuff time-out, over 160 pulses (C18)	Pulse waveform signal more than 160 beats are detected during measurement. There is a possibility that noise, patient movement or external vibrations. Confirm the patient is not moving and the cuff is free of external vibration, then, measure again.
NIBP: Retry, Cuff pressure failure (C19)	Cuff pressure exceeded more than 300mmHg during measurement. There is a possibility that the patient moved during measurement or strong pressure from outside might be added to cuffs. Considering above, measure again.
NIBP: Retry, Check cuff, hose and mode (C21)	Patient to be measured, and cuff size used, do not match. This error may occur if the blood pressure measurement mode setting is incorrect, if the cuff has been applied tightly in the adult mode loosely in the neonatal mode or if the arm has been bent during measurement. Check the measurement mode setting and application of the cuff, and measure again.
{label}: No zero reading.	Perform the pressure zero setting.

Alarm Messages	Check Items
SpO_2: Motion artifact.	SpO2 could not be measured due to signal noise thought to be due to body movement. Ensure that the patient remains at rest, and measure again.
SYSTEM: No recorder paper.	In case the recorder door is open, close the door. In case the recorder paper is empty, insert new paper and close the door.
SYSTEM: Abnormally shut down last time.	The monitor has been abnormally shut down last time. Contact qualified personnel in your facility or your local supplier.
SYSTEM: No recorder installed.	The recorder is not installed in your monitor. If required, contact your local supplier.

EMI (Electromagnetic Interference)

WARNING: Keep patients under close surveillance when monitoring. It is possible, although unlikely, that radiated electromagnetic signals from sources external to the patient and monitor can cause inaccurate measurement readings. Do not rely entirely on the monitor readings for patient assessment.

WARNING: It is possible that any radio frequency transmitting equipment and other nearby sources of electrical noise may result in disruption in the monitor operation.

WARNING: It is possible, although unlikely, that large equipment using a switching relay for its power on/off may affect monitor operation. Do not operate the monitor in such environments.

This device has been tested and found to comply with the limits for medical devices to the IEC60601-1-2, and the Medical Device Directive 93/42/EEC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

However, because of the proliferation of radio-frequency transmitting equipment and other sources of electrical noise in health care environments (such as electrosurgical equipment, defibrillator, cellular phones, mobile two-way radios, electrical appliances, and high-definition television), it is possible that high levels of such interference due to close proximity or strength of a source may affect monitor operation.

WARNING: The monitor is designed for use in environments in which the signal can be obscured by electromagnetic interference. During such interference, measurements may seem inappropriate or the monitor may not seem to operate correctly.

Monitor disruption may be indicated by erratic readings, cessation of operation, or other incorrect functioning. If this occurs, survey the site to determine the source of this disruption. Try the following actions to see if they eliminate the disruption:

- Turn equipment in the vicinity off and on to isolate the offending equipment.
- Reorient or relocate the interfering equipment.
- Increase the separation between the interfering equipment and this equipment.

The monitor generates, uses, and can radiate radio frequency energy. If the monitor is not installed and used in accordance with these instructions, the monitor may cause harmful interference with other devices in the vicinity.

If assistance is required, contact your local supplier.

Obtaining Technical Assistance

For technical information and assistance, or to order a monitor service manual, call your local supplier. The service manual provides information required by qualified service personnel when servicing the monitor.

When calling your local supplier, you may be asked to provide the software version number of your monitor. The software version is displayed when monitor power is activated.

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FACTORY DEFAULTS

General

The monitor is shipped with factory default settings. Authorized personnel can use the procedures described in the service manual to change default settings.

Parameter Ranges and Default Settings

Table 41. Parameter Ranges and Factory Defaults

Parameter	Ranges/Selections	Factory Defaults	
		Adult	Neonatal
ECG			
ECG Cable Select	3 Leads, 5 Leads, AUTO	AUTO	AUTO
ECG Lead Select	I, II, III, aVR, aVL, aVF, V(Chest Lead)	-	-
ECG Size (mm/mV)	×1/4, ×1/2, ×1, ×1.5, ×2	×1	×1
ECG Filter Mode	Monitor, Low Extend, Filter, Respiration Rejection	Monitor	Monitor
ECG Pacer Detect	On, Off	Off	Off
ECG Sweep Speed	12.5, 25.0, 50.0 mm/s	25.0 mm/s	25.0 mm/s
HR/PR Source	AUTO, HR, PR	AUTO	AUTO
HR/PR Upper Alarm Limits	35 to 305 BPM (Adult/Neo) (5 BPM steps)	180 BPM	200 BPM
HR/PR Lower Alarm Limits	30 to 300 BPM (Adult/Neo) (5 BPM steps)	40 BPM	50 BPM
NIBP			
NIBP Initial Cuff Inflation	120, 140, 160, 180, 200, 220mmHg (Adult) (16.0, 18.7, 21.3, 24.0, 26.7, 29.3, kPa) 80, 100, 120, 140 mmHg (Neo) (9.3, 12.0, 14.7, 16.0, 18.7 kPa)	180 mmHg 24.0 kPa	120 mmHg 16.0 kPa
BP On Alarm	On, Off	Off	Off
Smart Clock	On, Off	On	On
Smart Inflation	On, Off	On	On
Completion Sound	On, Off	On	On
NIBP Automatic Mode Interval	Off, Cont, 1, 2, 2.5, 3, 5, 10, 15, 20, 30, 45, 60, 90,120 ,180 minutes	Off	Off
NIBP SYS Upper Alarm Limits	60 to 260 mmHg (Adult), 40 to 130 mmHg (Neo) 8.0 to 34.7 kPa (Adult), 5.3 to 17.3 kPa (Neo) (10 mmHg / 1.3 kPa steps)	200 mmHg 26.7 kPa	130 mmHg 17.3 kPa
NIBP SYS Lower Alarm Limits	50 to 250 mmHg (Adult), 30 to 120 mmHg (Neo) 6.7 to 33.3 kPa (Adult), 4.0to 16.0 kPa (Neo) (10 mmHg / 1.3 kPa steps)	70 mmHg 9.3 kPa	50 mmHg 6.7 kPa
NIBP DIA Upper Alarm Limits	40 to 210 mmHg (Adult), 20 to 100 mmHg (Neo) 5.3 to 28.0 kPa (Adult), 2.7 to 13.3 kPa (Adult) (10 mmHg / 1.3 kPa steps)	160 mmHg 21.3 kPa	100 mmHg 13.3 kPa
NIBP DIA Lower Alarm Limits	30 to 200 mmHg (Adult), 10 to 90 mmHg (Neo) 4.0 to 26.7 kPa (Adult), 1.3 to 12.0 kPa (Neo) (10 mmHg / 1.3 kPa steps)	30 mmHg 4.0 kPa	10 mmHg 1.3 kPa
NIBP MAP Upper Alarm Limits	50 to 240 mmHg (Adult), 30 to 110 mmHg (Neo) 6.7 to 32.0 kPa (Adult), 4.0 to 14.7 kPa (Neo) (10 mmHg / 1.3 kPa steps)	180 mmHg 24.0 kPa	110 mmHg 14.6 kPa
NIBP MAP Lower Alarm Limits	40 to 230 mmHg (Adult), 20 to 100 mmHg (Neo) 5.3 to 30.7 kPa (Adult), 2.7 to 13.3 kPa (Neo) (10 mmHg / 1.3 kPa steps)	40 mmHg 5.3 kPa	20 mmHg 2.7 kPa

Parameter	Ranges/Selections	Factory Defaults	
		Adult	Neonatal
IBP			
IBP Sweep Speed	12.5, 25.0, 50.0 mm/s	25.0 mm/s	25.0 mm/s
Pressure Zero Setting	Yes, No	No	No
P1 Label	P1, ABP	ABP	ABP
P1 Scale	0~50, 0~100, 0~200, 0~300, AUTO	AUTO	AUTO
P1 SYS Upper Alarm Limits	-50 to 260 mmHg (Adult/Neo) (10 mmHg steps) -6.7 to 34.7 kPa (Adult/Neo) (1.3 kPa steps)	200 mmHg 26.7 kPa	130 mmHg 17.3 kPa
P1 SYS Lower Alarm Limits	-60 to 250 mmHg (Adult/Neo) (10 mmHg steps) -8.0 to 33.3 kPa (Adult/Neo) (1.3 kPa steps)	70 mmHg 9.3 kPa	50 mmHg 6.7 kPa
P1 DIA Upper Alarm Limits	-50 to 260 mmHg (Adult/Neo) (10 mmHg steps) -6.7 to 34.7 kPa (Adult/Neo) (1.3 kPa steps)	160 mmHg 21.3 kPa	100 mmHg 13.3 kPa
P1 DIA Lower Alarm Limits	-60 to 250 mmHg (Adult/Neo) (10 mmHg steps) -8.0 to 33.3 kPa (Adult/Neo) (1.3 kPa steps)	30 mmHg 4.0 kPa	10 mmHg 1.3 kPa
P1 MEAN Upper Alarm Limits	-50 to 260 mmHg (Adult/Neo) (10 mmHg steps) -6.7 to 34.7 kPa (Adult/Neo) (1.3 kPa steps)	180 mmHg 24.0 kPa	110 mmHg 14.7 kPa
P1 MEAN Lower Alarm Limits	-60 to 250 mmHg (Adult/Neo) (10 mmHg steps) -8.0 to 33.3 kPa (Adult/Neo) (1.3 kPa steps)	40 mmHg 5.3 kPa	20 mmHg 2.7 kPa
P2 Label	P2, CVP, PAP, LAP	CVP	CVP
P2 Scale	0~20, 0~50, 0~100, 0~200, 0~300, AUTO	AUTO	AUTO
P2 SYS Upper Alarm Limits	-50 to 260 mmHg (Adult/Neo) (10 mmHg steps) -6.7 to 34.7 kPa (Adult/Neo) (1.3 kPa steps)	200 mmHg	130 mmHg
P2 SYS Lower Alarm Limits	-60 to 250 mmHg (Adult/Neo) (10 mmHg steps) -8.0 to 33.3 kPa (Adult/Neo) (1.3 kPa steps)	70 mmHg 9.3 kPa	50 mmHg 6.7 kPa
P2 DIA Upper Alarm Limits	-50 to 260 mmHg (Adult/Neo) (10 mmHg steps) -6.7 to 34.7 kPa (Adult/Neo) (1.3 kPa steps)	160 mmHg 21.3 kPa	100 mmHg 13.3 kPa
P2 DIA Lower Alarm Limits	-60 to 250 mmHg (Adult/Neo) (10 mmHg steps) -8.0 to 33.3 kPa (Adult/Neo) (1.3 kPa steps)	30 mmHg 4.0 kPa	10 mmHg 1.3 kPa
P2 MEAN Upper Alarm Limits	-50 to 260 mmHg (Adult/Neo) (10 mmHg steps) -6.7 to 34.7 kPa (Adult/Neo) (1.3 kPa steps)	180 mmHg 24.0 kPa	110 mmHg 14.7 kPa
P2 MEAN Lower Alarm Limits	-60 to 250 mmHg (Adult/Neo) (10 mmHg steps) -8.0 to 33.3 kPa (Adult/Neo) (1.3 kPa steps)	40 mmHg 5.3 kPa	20 mmHg 2.7 kPa
SpO_2			
C-Lock	On, Off	Off	Off
PLETH Sweep Speed	12.5, 25.0, 50.0 mm/s	25.0 mm/s	25.0 mm/s
%SpO_2 Upper Alarm Limits	70 to 100 % (Adult/Neo) (1 % steps)	100 %	100 %
%SpO_2 Lower Alarm Limits	69 to 99 % (Adult/Neo) (1 % steps)	90 %	85 %
Respiration			
Apnea Time Setting	Off, 20, 30, 40, 50, 60 sec, Step 60, Step 90	30 sec	30 sec
Respiration/Apnea	Off, AUTO, awRR, imRR	AUTO	AUTO
Respiration Size	Graphic size bar (×1/4, ×1/2, ×1, ×1.5, ×2)	×1	×1
Respiration Sweep Speed	6.25, 12.5, 25.0 mm/s	12.5 mm/s	12.5 mm/s
RR Upper Alarm Limits	5 to 155 BPM (5 BPM steps)	30 BPM	50 BPM
RR Lower Alarm Limits	0 to 150 BPM (5 BPM steps)	0 BPM	0 BPM
Capno			
CAPNO Sweep Speed	6.25, 12.5, 25.0 mm/s	12.5 mm/s	12.5 mm/s
Scale	0~40, 0~60, 0~80, AUTO	AUTO	AUTO
Capno Measurement	On, Off	On	On
Calibration	Yes, No	No	No
$EtCO_2$ Upper Alarm Limits	2 to 80 mmHg (Adult/Neo) (2 mmHg steps) 0.3 to 10.7 kPa (Adult/Neo) (0.3 kPa steps) 0.3 to 10.5 % (Adult/Neo) (0.3 % steps)	80 mmHg 10.7 kPa 10.5 %	80 mmHg 10.7 kPa 10.5 %
$EtCO_2$ Lower Alarm Limits	0 to 78 mmHg (Adult/Neo) (2 mmHg steps) 0 to 10.4 kPa (Adult/Neo) (0.3 kPa steps)	0 mmHg 0 kPa	0 mmHg 0 kPa

Parameter	Ranges/Selections	Factory Defaults	
		Adult	Neonatal
	0 to 10.3 % (Adult/Neo) (0.3 % steps)	0 %	0 %
$InCO_2$ Upper Alarm Limits	2 to 20 mmHg (Adult/Neo) (2 mmHg steps) 0.3 to 2.7 mmHg (Adult/Neo) (0.3 kPa steps) 0.3 to 2.6 % (Adult/Neo) (0.3 % steps)	20 mmHg 2.7 kPa 2.6 %	20 mmHg 2.7 kPa 2.6 %
$InCO_2$ Lower Alarm Limits	0 to 18 mmHg (Adult/Neo) (2 mmHg steps) 0 to 2.4 kPa (Adult/Neo) (0.3 kPa steps) 0 to 2.3 % (Adult/Neo) (0.3 % steps)	0 mmHg 0 kPa 0 %	0 mmHg 0 kPa 0 %
Temperature			
T1, T2 Upper Alarm Limits	15.0 to 45.5 °C (Adult/Neo) (0.5º C steps) 59.0 to 113.9 °F (Adult/Neo) (0.1°F steps)	38.0 °C (100.4 º F)	39.0 °C (102.2 º F)
T1, T2 Lower Alarm Limits	14.5 to 45.0 °C (Adult/Neo) (0.5º C steps) 58.1 to 113.0 °F (Adult/Neo) (0.1°F steps)	14.5 °F (58.1 °F)	14.5 °F (58.1 °F)
Others			
Patient Mode	Adult, Neonatal	Adult	
Record Speed**	25.0 mm/s, 50.0 mm/s	25.0 mm/s	
Wave Record Time**	20 sec, Continuous (10sec delay)	20 sec	
Wave Record Select**	ECG1 + ECG2, PLETH, RESP, IBP1, IBP2 or CAPNO	ECG1 + PLETH	
Record on Alarm**	On,Off	Off	
Auto List Record**	On,Off	Off	
Alarm Volume	1, 2, 3, 4, 5, 6, 7, 8 (45to85dB)	5	
HR/PR tone Volume	Off, 1, 2, 3, 4, 5, 6, 7	4	
Key Beep Volume	Off, 1, 2, 3, 4, 5, 6, 7	4	
Sleep Mode	Off, 10, 20, 30 min	Off	
Main Screen	4ch-wave, 6ch-wave, Big Number	-	
Alarm Limits Display	On, Off	On	
Auto Alarm	On, Off	Off	
Auto Alarm Setting (Upper)	+10 to +50%	+40%	
Auto Alarm Setting (Lower)	-50 to -10%	-20%	
Save Time Interval	Off, 0.5,1,2,2.5,5,10,15,20,30,60,120 min	Off	
Graphical Display On/Off	On/Off for each parameter	On	
Save Setting on Power Off*	Custom, Back up, Default	Back up	
Audible Alarm Silence Period*	30, 60, 90, 120 sec	120 sec	
Audible Alarm Suspend Period*	Off, 10, 20, 30, 60 min, Indefinite (Alarm Inhibition)	Indefinite	
AC Line Frequency*	50, 60 Hz	60 Hz	
NIBP Unit*	mmHg, kPa	mmHg	
IBP Unit*	mmHg, kPa	mmHg	
CO_2 Unit*`	mmHg, %, kPa	mmHg	
Temperature Unit*	°C , °F	°C	
HR/PR Tone Set*	High, Med, Low, SpO_2	High	
Date Format*	year/month/day, month/day/year, day/month/year	year/month/day	
Jog Dial Speed	Fast, Normal	Normal	
Language*	한국어 (Korean), **中文** (Chinese), Dansk (Danish), Nederlands (Dutch), English, Français (French), Deutsch (German), Italiano (Italian), **日本語** (Japanese), Português (Portuguese), Español (Spanish), Svenska (Swedish)	English	

Note: An asterisk (*) by a parameter in the above table indicates that the parameter can only be changed by authorized personnel as described in the service manual

Note: Asterisks (**) by a parameter in the above table indicate the settings only when an optional recorder is installed in the monitor.

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SPECIFICATION

Display

Screen Size	10.4” measured diagonally across the TFT-LCD screen
Screen Type/Color	Liquid Crystal Display (LCD) Color, Cold Cathode Fluorescent Backlit
Resolution	800 × 600 pixel
Number of Traces	4 or 6 waveforms

Controls

Standard	Jog dial control; 7 soft buttons (NIBP start/stop, Main screen, NIBP interval, Alarm silence, Trend, Record, Power on/off)

Alarms

Categories	Patient Status and System Status
Priorities	Low, Medium and High Priorities
Notification	Audible and Visual
Setting	Default and Individual

Physical Characteristics and Recorder

Instrument		
Dimensions	360 × 280 × 215 (mm) (W×H×D) including a handle and excluding options and accessories	
Weight	5.5 kg excluding optional configurations and accessories	
Degree of Protection against Electric Shock	ECG: IBP(P1-P2): NIBP: SpO_2: Temperature (T1-T2): Gas(CO_2):	Type CF with defibrillator protection Type CF with defibrillator protection Type CF with defibrillator protection Type CF with defibrillator protection Type CF with defibrillator protection Type CF with defibrillator protection
Mode of Operation	Continuous	
Classification	Class IIb (MDD Annex IX Rule10:MEDDEV 2.4/1 Rev.8)	

Recorder (Optional)	
Type	Thermal
Weight	150 g
Resolution	8 dot/mm
Number of Channels	1 to 2 channels
Paper Type	Thermal
Paper Width	50 mm
Paper Speeds	25.0 mm/s and 50.0 mm/s

Electrical

Instrument	
Power Requirements	AC Mains 100-240V~50/60 Hz, 0.5-1.3A
Fuses	q'ty 2, T6.3 A, 250 volts, (time-lag), IEC (5×20 mm)
Battery	
A battery typically provides operating time of 1 hour when fully charged with no printing, no external communication, no audible alarm sound and one NIBP measurement per 5 minutes at 25°C.	
Type	Ni-MH
Voltage/Capacity	12 V/ 3.8 Ampere-Hours
Recharge	Over 12 hours with monitor turned on/off
Shelf Life	2 years, new battery fully-charged
Compliance	91/157/EEC

Environmental Conditions

Operation	
Temperature	10°C to 40°C (50°F to 104°F)
Humidity	15 % RH to 90% RH, non-condensing
Altitude	500hPa to 1060hPa
Transport and Storage (in shipping container)	
Temperature	−20°C to 60°C (−4°F to 140°F)
Humidity	15 % RH to 95% RH, non-condensing
Altitude	500hPa to 1060hPa
Note: The system may not meet its performance specifications if stored or used outside the specified temperature and humidity range.	

Measurement Parameters

ECG

Heart Rate	
Measurement Range	20 BPM ~ 250 BPM
Accuracy	±3 BPM or ±5% whichever is greater
ECG (Electrocardiograph)	
Leads	3 / 5 Lead Lead I, II, III, aVR, aVL, aVF, V (Chest Lead)
Lead Off Detection	Detected and displayed
Input	
Input Dynamic Range	±5 mV AC, ±300 mV DC
Voltage Range	±0.5 mV ~ ±5 mV
Signal Width	40 ms ~ 120 ms (Q to S)
Output	
Frequency Response (Bandwidth)	
Low Extend	0.05 Hz ~ 40 Hz
Filter	0.5 Hz ~ 30 Hz
Monitor	0.5 Hz ~ 40 Hz
Respiration Rejection	1 Hz ~ 40 Hz
ECG Size	×1/4, ×1/2, ×1, ×1.5, ×2
Display Sweep Speeds	12.5 mm/sec, 25.0 mm/sec, and 50.0 mm/sec
Defibrillator Discharge Recovery	<5 sec per IEC60601-2-27>

Respiration

im RR	
Technique	Trans-thoracic impedance
Range	0, 3 to 120 breaths/min
Accuracy	±3 breaths/min
Leads	RA to LA
Display Sweep Speeds	6.25 mm/s, 12.5 mm/s, 25.0 mm/s
Lead Off Condition	Detected and displayed

aw RR (Option)	
Technique	Nondispersive Infrared Spectroscopy
Range	0 to 120 breaths/min
Accuracy	±1 breath/min
Display Sweep Speeds	6.25 mm/s, 12.5 mm/s, 25.0 mm/s

Pulse Rate	
Pulse Rate Range	Adult 40 BPM ~ 200 BPM Neonatal 40 BPM ~ 240 BPM
Pulse Rate Accuracy	±2 BPM or ±2%, whichever is greater
NIBP (Non-Invasive Blood Pressure)	
Technique	Oscillometric Measurement
Measurement Modes	MANUAL, AUTO and CONT
MANUAL Mode	Single measurement initiated by *NIBP Start/Stop button*
AUTO Mode	Automatic BP measurements at intervals of 1, 2, 2.5, 3, 5, 10, 15, 20, 30, 45, 60, 90, 120, or 180 minutes
CONT Mode	Series of consecutive measurements for 5 minutes
NIBP Pressure Measuring Range	
Systolic Pressure Range	Adult 60 mmHg ~ 250 mmHg Neonatal 40 mmHg ~ 120 mmHg
Diastolic Pressure Range	Adult 40 mmHg ~ 200 mmHg Neonatal 20 mmHg ~ 90 mmHg
MAP Pressure Range	Adult 45 mmHg ~ 235 mmHg Neonatal 30 mmHg ~ 100 mmHg
NIBP Accuracy	Mean error and standard deviation per ANSI/AAMI SP10:2002
Pressure Display Range	10 mmHg ~ 300 mmHg
Pressure Display Accuracy	±3mmHg
Initial Cuff Inflation	Adult 120, 140, 160, 180, 200, 220, mmHg (16.0, 18.7, 21.3, 24.0, 26.7, 29.3, kPa) Neonatal 80, 100, 120, 140 mmHg (9.3, 12.0, 14.7, 16.0, 18.7 kPa)
Automatic Cuff Deflation	Measurement time exceeding 180s in adult/pediatric (90s in neonatal) or maximum pressure value exceeding 300 mmHg in adult (150 mmHg in neonatal).
Overpressure Protector	300 ±10 mmHg for Adult 150 ±5 mmHg for neonatal

SpO_2

Pulse Rate		
Range	20 BPM ~ 250 BPM	
Accuracy	Without Interference	20 BPM ~ 250 BPM ±3 digits
	Low Perfusion	20 BPM ~ 250 BPM ±3 digits
SpO_2		
Range	1% to 100%	
Low Perfusion	0.03% to 20%	
Accuracy	Without Interference-Adult	
		70% ~ 100% ±2 digits
		1% ~ 69% unspecified
	Without Interference-Neonate	
		70% ~ 100% ±3 digits
		1% ~ 69% unspecified
	Low Perfusion	70% ~ 100% ±2 digits
		1% ~ 69% unspecified
Display Sweep Speeds	12.5 mm/sec, 25.0 mm/sec and 50.0 mm/sec	

Neonatal specifications are shown for neonatal sensors with the monitor. Saturation accuracy will vary by sensor type as specified by the manufacturer.

Note: The wavelength range of the light emitted are near 660 nm and 890 nm with the energy not exceeding 15mW.

Temperature

Probe Type	Thermistor probe YSI 400 series
Parameter Displayed	T1, T2
Range	15°C ~ 45°C (59°F to 113°F)
Display Accuracy	±0.1°C (25°C to 45°C) or ±0.2°F (77°F to 113°F) ±0.2°C (15°C to less than 25°C) or ±0.4°F (59°F to less than 77°F)
Probe Accuracy	±0.1°C (±0.2°F)

IBP

Pulse Rate	
Range	20 BPM ~ 250 BPM
Accuracy	±1% or ± 1 beat
IBP	
Parameter Displayed	P1, ABP P2 , CVP, PAP, LAP
Pressure Measuring Range	-50 mmHg ~ 300 mmHg
Input Impedance	More than 1 M ohm
Transducer Driving Voltage	DC 5V
Transducer Input Sensitivity	5uV/V/mmHg
Zero Calibration Range	± 100mmHg
Zero Calibration Accuracy	Less than ±1mmHg
Frequency Characteristics	dc to 25Hz
Pressure Display Accuracy	Monitor: Less than ±3mmHg
Scale	P1 0~50, 0~100, 0~200, 0~300, AUTO P2 0~20, 0~50, 0~100, 0~200, 0~300, AUTO
Display Sweep Speeds	12.5 mm/sec, 25.0 mm/sec, and 50.0 mm/sec

Capnography

Parameter Displayed	$EtCO_2$, $InCO_2$
Range	0 mmHg ~ 100 mmHg; 0 kPa ~ 13.3 kPa; 0 % ~10 % CO_2 STPD (standard temperature and pressure dry)
Accuracy	±2mmHg or ± 4%, whichever is greater
Stability	< 0.3 % (vol) CO_2 /24hrs
Rise Time	400 ms (average)
Delay Time	1.8 (average)
System Response	2.1 (average)
Warm Up Time	3 minutes average
Display Sweep Speeds	6.25mm/sec, 12.5 mm/sec and 25.0 mm/sec
Sound Noise Level	Less than 41dB when ambient sound pressure level is 22dB
Rise Time of Flow Rate	1.0 sec at normal condition
at flow rate of 10 l/min	2.0 sec after sustained pressure
Fall Time of Flow Rate	1.2 sec at normal condition
at flow rate of 10 l/min	2.2 sec after sustained pressure

Trends

Types	Graphical and Tabular
Memory	saves total 1500 data saves at selected time interval saves alarm condition & error events saves NIBP Measuremets
Graphical Format	Total 2 graphs a graph for NIBP, P1/P2, SpO_2, T1/T2 parameters a graph for HR/PR, Resp, $EtCO_2$ parameters User-selectable each parameter to be desired
Tabular Format	One table for all parameters
Display	8 lists
Save Time Interval	30sec or 1, 2, 2.5, 5, 10, 15, 20, 30, 60 or 120 minutes

Compliance

Item	Compliant with
Classification	Class I (on AC power) Internally powered (on battery power)
Type of protection	Type CF – Applied part
Mode of operation	Continuous
Degree of protection	IP21 (provided by enclosures)
General	93/42/EEC Directives for medical devices
	21CFR820 Code of Federal Regulations
	2002/96/EC Waste electrical and electronic equipment Directive(WEEE)
	91/157/EEC Battery Declaration Directive
	93/86/EEC Battery Disposal Directive
	ISO9001:2000 Quality Management Systems - Requirements
	ISO13485:1996 Quality Systems– Medical Devices –Particular requirements for the application of ISO9001
	ISO14971:2000 Risk analysis managements – medical devices
	IEC60601-1:1988+A1:1991+A2:1995 General requirements for Safety and Essential Performance
	IEC60529:2001 Degree of Protection Provided by Enclosures (IP21)
	EN ISO14155-1:2003 Clinical investigation of medical devices for human subjects – part 1: General requirements
	AAMI HE48:1993 Human factors engineering guidelines and preferred practices for the design of medical devices
	IEC60601-1-1:2000 Safety requirements for medical electrical systems
	IEC60601-1-4:2000 Particular requirements for programmable medical systems
	IEC60601-1-6:2004 Medical electrical equipment Part 1-6: General requirements for safety Collateral Standard: Usability
	ISO10993-1:2003 Biological evaluation of medical devices – Part 1: Evaluation and testing
	IEC60601-2-49:2001 Particular requirements for multifunction patient monitoring equipment
Alarms	IEC60601-1-8:2003 Alarm systems requirements, tests and guidances in medical electrical equipments systems
Electrocardiograph	IEC60601-2-27:1994 Particular requirements for the safety of Electrocardiographic monitoring equipment
	AAMI EC13:2002 Cardiac monitors, heart rate meters and alarms
	AAMI EC53:1995+A1:1998 ECG cable and leads
Non-invasive blood pressure	AAMI SP10:2002+A1:2003 Electronic or Automated Sphygmomanometers
	EN1060-1:1995+A1:2002 Non-invasive sphygmomanometers
	EN1060-3:1997 Supplementary requirements for electrical-mechanical blood pressure measuring systems
	IEC60601-2-30:1999 Particular requirements for the Safety, including essential performance, of automatic cycling indirect blood pressure monitoring equipment
Oxygen saturation	EN865:1997 Pulse oximeters, Particular requirements
	ISO9919:2005 Basic safety & essential performance of Pulse oximeter for medical use
Temperature monitoring	EN12470-4:2000 Performance of Electrical Thermometers for continuous Measurement

Item	Compliant with
Invasive blood pressure	IEC60601-2-34:2000 Particular requirements for the safety, including essential performance, of invasive blood pressure monitoring equipment
Capnography	EN864:1996 Capnometers for use with humans-Particular requirements
	ISO9918:1993 Capnometers for use with humans-Requirements
	ISO21647:2004 Particular requirements for the basic safety and essential performance of respiratory gas monitors
Electromagnetic compatibility	IEC60601-1, sub clause 36, IEC/ IEC60601-1-2:2001+A1:2004 Electromagnetic compatibility-requirements & test
	IEC61000-3-2:2005 Harmonic Emission Ed 3.0
	IEC61000-3-3:2005 Voltage Fluctuations/Flicker Emission Ed 1.2
	IEC61000-4-2:2001 Electrostatic Discharge Ed 1.2
	IEC61000-4-3:2002 Radiated RF electromagnetic field Ed 2.1
	IEC61000-4-4:2004 Electrical fast transient/burst Ed 2.0
	IEC61000-4-5:2005 Surge current Ed 2.0
	IEC61000-4-6:2004 Conducted disturbances, induced by RF field Ed 2.1
	IEC61000-4-8:2001 Power frequency (50/60Hz) magnetic field Ed 1.1
	IEC61000-4-11:2004 Voltage dips, short interruption and voltage variation on power supply input lines Ed 2.0
	CISPR 11:1997 (EN55011:1998) Limits and methods of measurement of radio disturbance characteristics of industrial scientific and medical (ISM) radio-frequency equipment RF Emissions Group 1, Class B
Package	ISTA (Procedure 1A, 1994 Rev.) Pre-Shipment Test Procedures (Package)
Reliability	IEC60068-2-27:1987 Environmental testing – Shock
	IEC60068-2-6:1995 Environmental testing –Vibration
	IEC60068-2-64:1993 Environmental testing: vibration, broad-band random (digital control) and guidance
Labeling	EN1041:1998 Information supplied by the manufacturer with medical devices
Marking	IEC /TR60878:2003 Graphical symbols for electrical equipment in medical practice
	EN980:2003 Graphical symbols for use in the labeling of medical devices
	ISO7000:2004 Graphical symbols for use on equipment-index and synopsis
	EN60417-1:1999 Graphical symbols for use on equipment-overview and application
	EN60417-2:1999 Graphical symbols for use on equipment-symbol originals
	EN50419:2005 Marking of electrical and electronic equipment in accordance with article II (2) of directive 2002/96/EC (WEEE)

Manufacturer's Declaration

WARNING: For best product performance and measurement accuracy, use only accessories supplied or recommended by Colin Medical Technology. Use accessories according to the manufacturer's directions for use and your facility's standards. The use of accessories, transducers, and cables other than those specified may result in increased emission and/or decreased immunity of the BP-S510.

The BP-S510 is suitable for use in the specified electromagnetic environment. The customer and/or user of the BP-S510 should assure that it is used in an electromagnetic environment as described below;

Table 42. Electromagnetic Emissions (IEC60601-1-2)

Emission Test	Compliance	Electromagnetic Environment
RF emission CISPR 11	Group 1	The BP-S510 must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF emissions CISPR 11	Class B	The BP-S510 is suitable for use in all establishments.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emission IEC 61000-3-3	Complies	

Table 43. Electromagnetic Immunity (IEC60601-1-2)

Immunity Test	IEC60601-1-2 Test Level	Compliance Level	Electromagnetic Environment Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floor should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electric fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial and/or hospital environment
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial and/or hospital environment
Voltage dips, short interruptions and voltage variations on power supply	<5 % U T (>95 % dip in UT) for 0.5 cycle	<5 % U T (>95 % dip in U T) for 0.5 cycle	Mains power quality should be that of a typical commercial and/or hospital environment. If the user of the BP-S510 requires continued operation during power mains interruption, it is recommended that the BP-S510 be powered from an uninterruptible power supply or battery.
IEC 61000-4-11	40 % U T (60 % dip in UT) for 5 cycles	40 % U T (60 % dip in U T) for 5 cycles	
	70 % U T (30 % dip in UT) for 25 cycles	70 % U T (30 % dip in UT) for 25 cycles	

Immunity Test	IEC60601-1-2 Test Level	Compliance Level	Electromagnetic Environment Guidance
	<5 % U T (95 % dip in UT) for 5 sec.	<5 % U T (95 % dip in UT) for 5 sec.	
Power frequency (50/ 60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	It may be necessary to position the BP-S510 further from the sources of power frequency magnetic fields or to install magnetic shielding. The power frequency magnetic field should be measured in the intended installation location to assure that it is sufficiently low.
Note: UT is the AC mains voltage prior to application of the test level.			

Table 44. Electromagnetic Immunity (IEC60601-1-2)

Immunity Test	IEC60601 test level	Compliance level	Electromagnetic environment guidance
The BP-S510 is intended for use in the electromagnetic environment specified below. The customer or the user of the BP-S510 should assure that it is used in such an environment.			
			Potable and mobile RF communications equipment should be used no closer to any part of the BP-S510 including cables, than the recommended separation distance calculated from the equation appropriate to the frequency of the transmitter. **Recommend separation distance**
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	$d = 1.2\sqrt{p}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 800 MHz	3 V/m	$d = 1.2\sqrt{p}$ 80 MHz to 800 MHz
	3 V/m 800 MHz to 2.5 GHz	3 V/m	$d = 2.3\sqrt{p}$ 800 MHz to 2.5 GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to he transmitter manufacturer and *d* is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters as deter-mined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with he following symbol:
Note: At 80 MHz and 800 MHz, the higher frequency range applies. Note: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.			

Immunity Test	IEC60601 test level	Compliance level	Electromagnetic environment guidance
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/ cordless) telephones and land mobile radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the BP-S510 is used exceeds the applicable RF compliance level above, the BP-S510 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the BP-S510. [b] Over the frequency range 150 kHz to 80MHz, field strengths should be less than 3 V/m			

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and the BP-S510. (IEC60601-1-2)

Table 45. Recommended Separation Distances

Recommended separation distance between Portable and mobile RF communications equipment and the BP-S510			
The BP-S510 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of he BP-S510 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the BP-S510 as recommended below, according to the maximum output power of the communications equipment.			
Rated Maximum Output Power of Transmitter in watt	**Separation distance according to frequency of transmitter in meter**		
	150 kHz to MHz $d = 1.2\sqrt{p}$	***80 MHz to 800 MHz*** $d = 1.2\sqrt{p}$	***800 MHz to 2.5GHz*** $d = 2.3\sqrt{p}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. Note: At 80MHz and 800MHz, the separation distance for the higher frequency range applies Note: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.			

Table 46. Cables (IEC60601-1-2)

Cables and Sensors	Maximum Length	Complies with
Pulse oximetry extension cable	10 ft. (3 m)	-RF emissions, CISPR 11, Class B/ Group 1 -Harmonic emissions, IEC 61000-3-2 -Voltage fluctuations/flicker emission, IEC 61000-3-3 -Electrostatic discharge (ESD), IEC 61000-4-2 -Electric fast transient/burst, IEC61000-4-4 -Surge, IE 61000-4-5 -Conducted RF IEC 61000-4-6 -Radiated RF, IEC 61000-4-3
RS-232 serial communication cable, 9 pin “D”	10 ft. (3 m)	
Non-terminated cable, RS-232, 9 pin “D”	10 ft. (3 m)	
Reusable SpO_2 sensor	3 ft (0.91 m)	
AC power cord	10 ft. (3 m)	